CHALLENGES IN INFORMATION, COMMUNICATION AND COMPUTING TECHNOLOGY

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Edited by
V. Sharmila, S. Kannadhasan, A. Rajiv Kannan,
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CHALLENGES IN INFORMATION, COMMUNICATION AND COMPUTING TECHNOLOGY

This book explores the critical challenges and emerging trends in Information, Communication, and Computing Technology (ICCICCT). It provides a comprehensive overview of the key issues facing these rapidly evolving fields, from data security and privacy to advancements in artificial intelligence, communication networks, and quantum computing. Through in-depth analysis and expert perspectives, this volume aims to shed light on the complexities of ICCICCT and offer innovative solutions for researchers, practitioners, and students.

Building on its exploration of challenges in ICCICCT, this book delves into several core areas. These include the development and deployment of secure and efficient communication networks, the ethical implications and technical hurdles of artificial intelligence and machine learning, and the promise and complexity of quantum computing. The book also addresses the management of big data, highlighting both its potential and the challenges of ensuring data privacy and security. Additionally, it examines the role of sustainability in computing, advocating for greener technologies and practices. The findings presented in this volume emphasize the need for interdisciplinary approaches and innovative thinking to address these challenges, offering insights that are both practical and forward-looking.

This book is intended for a diverse audience that includes researchers, practitioners, and students in the fields of Information, Communication, and Computing Technology (ICCICCT). It is particularly valuable for academics and professionals seeking to deepen their understanding of current challenges and emerging trends in these areas. Additionally, policymakers, industry leaders, and technologists will find the book's insights useful for informing decisions and strategies in the development and implementation of advanced technologies. Whether you are a seasoned expert or a newcomer to the field, this book provides valuable perspectives that can enhance your knowledge and contribute to your work in ICCICCT.

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Challenges in Information, Communication and Computing Technology

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Table of Contents

Preface xvii
Committee List xix

Computer vision and IoT

Accident detection and human rescue system 3
M. Dharani, N. Subbarayudu, M.V. Sruthi, A. Venkata Srinivasa Rao, T. Venkatakrishnamoorthy & M. Bharathi

AI based framework for automatic vehicle number plate detection 9
Nidhi Mehra, Shivam Petwal, Divya Kapil, Tabish Rao, Atika Gupta & Harendra Singh Negi

An integrated mobile solution for smart irrigation management and monitoring with IoT technology 14
V. Janakiraman, R. Seranmadevi, Gaurav Vishnu Londhe, Saurabh Gangola, Gollu Twikil & Marrapu Aswini Kumar

An IoT sensors enabled smart car parking system 19
Shraddha Kaparwan, Siddhartha Tomar & Ganga Negi

Arduino PulseCraft: Designing your heart's symphony 24
Lokesh Khedekar, Aryan Bajaj, Arnav Baldawa, Shashank Barge, Yuvraj Bhambare & Atharva Kadu

Creating and deploying a wearable sensor network system for safety and health applications in the IoT ecosystem 30
Anjali Sandeep Gaikwad, Chandan Choubey, Gaurav Vishnu Londhe, Malleswari Akurati, Srinivas Jangirala & Burri Ankaiah

Creative sustainability: Transforming household waste in India – A public survey on awareness and participation 36
L. Khedekar, A. Pandit, R. Apte, B. Adke, P. Ambade & A. Aher

Design and development challenges of TCLA adder for low power applications: A review 42
Mohammad Taj, C. H. Meher Chakravarthy, N. Bhuvana Sri, P.V.V.N. Satya Ganga Gowri & R. Rakesh

Detecting anomalies in IoT sensor data using machine learning algorithms 47
Vidur Mehta, Shubhangi Sharma & G. Abirami

Detection and prevention of IP address spoofing in smart environment using Zigbee networks 53
Bhawana Parihar, V. Chandrashekhar, Sivakumar Ponnusamy, Gunjan Chhabra, M. Arivukarasi & Anup Bhange

Detection of toxic gasses in laboratory using IoT based system 60
Saurabh Pargaien, Jeevan Pandey, Amita Joshi Rana, Arpita Bhakuni, Ankita Bhandari & Heena

Development of cloud infrastructure with improved auto scaling and elasticity with real time data analytics 65
Neetu Udgirkar, Chintolla Surekha, Balusamy Nachiappan, Samadhan Bhikaji Jadhav, Satvik Vats & Vaishali N. Agme

Development of smart baby cradle system using IoT 71
Singaram M.Nithya S.Anirudh J.Athish C.B.Arun Karuppiah R. & S. Gokul Prasath

Empowering troop safety with advanced position and health monitoring using LoRa 76
G.K. Jakir Hussain, S. Goutham, R. Indraes, R. Jagadish & S. Abhishekh

Enhanced kitchen safety system 82
S. Thangam, M. Gurupriya, Agastya, Rishikesh, Hemanth & Gnanesh

Enhancing sustainability and efficiency through automation and wireless sensor network-controlled irrigation system 88
C. Madana Kumar Reddy, Rakesh Kumar Yadav, Vijaykumar S. Biradar, M. Rohitha, Angeline Ranjithamani & M. Selvavathi

Exploring advanced learning capabilities in an Internet of Things (IoT) based smart plant irrigation system 94
M. Saravanan, Srinivas Jangirala, Dheyaaldeen Faez Sahib, Parul Chaudhary, J. Jerome Santiago & B. Vishnu Vardhana Naidu

Facial recognition attendance system: Embracing openCV for real-time monitoring 100
Neeraj Panwar, Akash Nautiyal, Deepti Negi, Abhishek Jain, Harendra Singh Negi & Navjyoti Singh Negi

GPS using attendance tracking system 106
C. Nallusamy, R.S. Gowri & S. Hari Priya

Health guardian: Employing machine learning for early detection and management of chronic diseases to improve healthcare and patient outcomes 112
Prateek, Himanshu Maurya, Sukhjit Singh, Ayushi Khullar & Ashu Mehta

Herbal garden monitoring using IOT based system 118
Saurabh Pargaien, Amita Joshi Rana, Neha Bohra, Rajat Dumka, Bhawna Pandey & Akbar Nawaz

Industrial surveillance and monitoring system 124
Swati Nitnaware, Shrutika Mendhekar, Shreyash Bhandarkar, Anshika Awasthi, Arya Dautpure & Aman Jawade

IoT adoption with AI for enhancing operational resilience in business transformation 130
Priti Verma, Gunjan Chhabra & Jayanthi Ranjan

IoT-powered street light management: Enhancing fault detection and reporting 136
P. Sukumar, S. Jayasurya, M. Rohith, E.S. Premnath, K. Sugumar & V. Mythily

Li-Fi-enabled smart indoor navigation system with obstacle detection and voice assistance for visually impaired individuals 141
N. Antony Sophia, N. Deepika, M. Vigneshwari, P. Swarna Lakshmi, E. Venitha & K. Priya Kalaivani

License plate recognition using computer vision 147
T. Manikumar, S. Balamurigan, J. Ragaventhiran, M. Islabudheen, K. Venkatesh & S. Kumarappan

Multi-sensor approach leveraging IoT for comprehensive wildlife conservation: Addressing threats and enhancing monitoring efficiency 152
Savita Vijay & M.K. Banga

Smart care for asthma: A machine learning-based CDSS 158
Shruti Patil & Shivaleela Patil

Healthcare and medicine using computing technology

Security-driven data analytics for secure patient monitoring in healthcare application using secure hash algorithm (256) 167
G. Moheshkumar, P. Meenakshi Devi, G. Karthick, S. Kousika & N. Nasir Akhtar Jamali

Design of fabric-based textile antenna for enhanced healthcare monitoring systems 173
M. Singaram, M. Gowtham, K. Aravind, G. Aravinthan, S. Aswin & V. Seethalakshmi

Specific absorption rate (SAR) in organs of human beings 179
V. Kumar, S. Gupta, A. Verma & F.S. Gill

Revolutionizing healthcare: Unveiling the transformative impact of AI and deep learning in the era of intelligent medicine 185
Aditi Rawat, Adarsh Tomar, Rahul Chauhan & Ruchira Rawat

AI pharma insights: Transforming the future of healthcare 191
Neema Bisht, Vishal, Sandeep Bisht, Archana N. Sah & Himanshu Joshi

Practicing mindfulness through web-based technologies during Covid-19 scenario 197
D. Tewari, M. Kumar, S. Sengupta & A. Misra

An in-depth analysis of gastrointestinal abnormalities using endoscopic imaging and deep learning 202
N. Niharika, S. Srinivasulu Raju, R. Akash, Imtiyaz Hussain & K. John Victor

Technology integration with human resource in organizations during Covid-19 208
S. Tewari, A. Joshi, D. Tewari & A. Misra

Impact of artificial intelligence in enhancing pharmacovigilance 213
Himanshu Joshi, Amrita Verma Pargaien, Bhawana Chilwal, Sameer Goel, Arpita Bhakuni & Heena

Blockchain revolution in healthcare: A comprehensive survey 218
Anshika Sharma, Rahul Chauhan, Sneha Gupta & Akanksha Kapruwan

A novel approach to diagnosing PCOS through tunica albuginea oculi 224
A. Sri Krishna, S. Anandaraj, Mahaboob Sazna Shaik, Naga Jyothirlatha Surarapu & Pallavi Donapati

Integration of machine learning with computational drug discovery for identifying potential inhibitors against pathogens – A case study with HIV and *E. coli.* 229
Preetham R.S., Sanjana Mathias, Hiba Muskan, Ananya R., Sanjay Shrinivas Nagar & R.S. Upendra

Improved health record management with disease forecasting in urban areas using deep learning with blockchain technology 234
Venkateswarlu Sunkari, Daniel Pilli, Chitralekha Navneet Kumar, Ankita Nathuji Jeewankar, Y. Md. Riyazuddin & Marrapu Aswini Kumar

Identification of neurodegenerative disease using genomic data using deep learning algorithms 240
Amarja Adgaonkar, Lakshmi B.N., Ashish, V. Jagadish Kumar, Devika Rani Roy & Marrapu Aswini Kumar

Phylogenetic analysis of mucormycosis (Black Fungus) using ML techniques 246
S. Shalen Janet, V. Yashasvi, M. Prerana, Sanjay Shrinivas Nagar, R.S. Upendra & R. Karthik

Molecular docking studies of selected target proteins of *Candida auris* employing machine learning (ML) methods 252
S. Nuzhath Ameen, Shreya G., Sreya Karipody Ravindran & Sanjay Shrinivas Nagar, R.S. Upendra & R. Karthik

A survey on machine learning inspired healthcare informatics studies of COVID-19 disease 256
R.S. Upendra, Sanjay Shrinivas Nagar, M.S. Upamanyu, Sandhya A.R. & R. Karthik

Combination of machine learning and computational vaccine discovery to develop multi-epitope vaccine against viral diseases (Dengue virus (DENV)) 261
V. S Yena Prasad, V. Deepika, D. Sanjana, Yuktha Dabke & Sanjay Shrinivas Nagar, R.S. Upendra

The role of machine learning in drug repurposing 266
Amrita Verma Pargaien, Mansi Adhikari, Amita Joshi Rana, Vaibhav Kumar Bhagat, Pragya Sharma & Akbar Nawaz

Enhancing thyroid disorder diagnosis with machine learning: Overcoming challenges for accurate detection 271
Y. Indira Priyadarshini, Athuluri Neha, Divam Dinne Shavukarla Mounika, Kotipalli Pranathi & Gowrava Sandhya

Natural remedies for management of primary dysmenorrhea in adolescent girls 276
Pooja Thapa, Pratiti Haldar & Shweta Goyal

Construction of big data platform for Indian herbal medicine based on data acquisition 281
Kanak Pandey, Sonia Paliwal & Neema Bisht

Nursing in the digital age: A study of transformative impact of AI on healthcare practices 287
Hansi Negi, Saurabh Pargaien, Akbar Nawaz, Pragya Sharma, S.N. Deepak & U.K. Saravana Kumar

Brain tumor detection using integrated approach of FCM & convolutional neural network 292
Sanjana Saxena, Rahul Chauhan, Chandradeep Bhatt & Swati Devliyal

Health care application for brain disease 299
N. Antony Sophia & Vaibhav Arora

Diagnosis of utrine cervical cancer using deep learning 305
S. Priyadarsini, A. Mareeswari, M. Subhashini & N. Gayathri

Leveraging MobileNet for efficient deep learning classification of poly cystic ovary syndrome (PCOS) in ultrasound images 310
K. Shanmugapriya, K.S. Gobinath, R. Kaviya & M. Mounica

Detection of early spread of vector borne disease with personalized treatment strategies using machine learning 316
Arun B. Prasad, K. Prabhu, Kavyashree Nagarajaiah, Juhie Agarwal, A. Srilakshmi & Rakesh Verma

Analysis of sound intensity for male voice using smartphone sensor 322
V. Sharma, V. Kumar, P. Pathak & F.S. Gill

Predictive modeling for water borehole drilling using machine learning techniques 328
D. Vanathi, D. Preethishri, V. Ragul, A. Rajkumar & B. Vanishree

Disease detection and doctor recommendation using machine learning 335
V. Mythily, R. Arunraja, K. Dharshan, S. Pranesh & R. Pranith

An efficient method of diabetes prediction using machine learning 341
S. Siva Nageswara Rao, Ch. Padma, V. Mahesh Babu & Y. Chandana

Exploring machine learning methods for breast cancer detection: A comparative analysis of classification techniques 347
Deepti Negi, Sukh Simran Kaur, Aditya Harbola, Amit Juyal, Vandana Rawat & Navjyoti Singh Negi

Deepfake detection over different media types using deep learning algorithms 353
B. Arshath, M. Balaji, A. Bhavan Surya & L. Hariprasath

Screening, docking and ADME studies of the phytochemicals present in *Rhododendron Arboreum Sm.* against myocardial infraction through computational approaches 359
Neema Bisht, Sandeep Bisht, Archana N. Sah, Kanak Pandey & Sonia Pandey

Improved plant leaf disease classification using meta-heuristic algorithm based deep learning 365
N. Pravin, P. Sukumar, S. Karuppusamy, V. Mythily, S. Kavitha & D. Vinoparkavi

Machine learning approaches for early hemorrhagic stroke prediction 370
N. Saravanan, P. Meenakshi Devi, S. Dhanush, E. Dhanushiya & A. Harish Kumar

Machine learning based optimization of resource management with control strategies in smart grid using IoT 375
K. Jamberi, T. Venketbabu, Narender Chinthamu, V. Vennila, Rahul Chauhan & Nallam Krishnaiah

COVID-19 prediction classification models comparison by patient's symptoms and medical history 381
Mohit Pant & Anurag Vidyarthi

Digitalized college management system 387
K. Senthil Kumar, K. Monishwaran, D. Naveen & D. Srimathi

Lung cancer detection using Resnet architecture: Lung nodule detection in CT images 391
Sakarvadia Maitri Rashmikant & Sankarsan Panda

Demystifying heart disease prediction: The role of iris imaging and explainable AI 396
S. Geetha, B. Deepa, I. Sivaranjani, M. Sowmiya, P. Karthick & N.K. Priyadharshini

Diagnosis of autism spectrum disorder using deep learning with natural language processing 402
Gaurav Vishnu Londhe, P. Sukumar, Baiju Krishnan, B. Yamini Supriya, R. Karthik & C. Hemalatha

Exploring machine learning and deep learning models for forecasting bitcoin price trends 407
V. SimhadriAppanna, M. Manohara, B.V. Sai Thrinath, D. Leela Rani, C. Sudharshan Reddy & K. Ganesh

Machine learning and deep learning approaches for brain disease diagnosis: Principles and recent advances 413
P. Devika, M. Tharun, R. Swetha, G.B. Rubansanthosh & S. Sanjaikumar

An integration of electrical vehicle into grid along with hybrid energy storage system for power management 418
S. Farook, U. Rama Lakshmi, N. Likitha, S. Yaswanth, B. Sai Kumar Nayak & B.V. Sai Thrinath

Enhancing rice grain classification using color features and self learning neural network model 425
Kishori Kasat, Shaik Meer Subhani Ali, Jayendra Gopal Thatipudi, Anupam Singh, Chappeli Sai Kiran & Aakunuri Manjula

Assessment of organizational human resource management performance through machine learning techniques 431
Yashomandira Kharde, A. Basi Reddy, Sivajee Vavilapalli, S. Susendiran, Vilis Pawar & Shaifali Garg

Skin disease detection using CNN 437
M. Shankar, S. MD. Rehaman, S. MD. Naveed, P. MD. Ayub Khan & S. Mushraq

Comparative analysis of multi-class classification deep network for MRI images using ML based augmentation technique 443
Baba Ameer Shaik, Mudumala Varnika Narayani & Adapala Rishi Manikanta, Naga Ruthvika Durupudi, Tegulapalle Venkateswara Reddy & Gayathri Ramaswamy

Revolutionizing cirrhosis liver disorder diagnosis: A deep learning approach with convolutional neural networks 449
Ajmeera Kiran, Vikram Neerugatti, Duggirala Syam Kumar, J. Somasekar, Santhosh Boddupalli & B. Sai Praneetha

Agriculture and environment using AL, DL

AI-based animal emotion detection and application 457
Rahul Chauhan, Daksh Prajapati, Kavetri Bhatt & Ruchira Rawat

AI-powered weed bot for sustainable precision farming 464
R. Jaikumar, S.A. Sanjai, C. Sanjay, S. Syed Abdul Kalam & P. Nithish Kumar

Animal data analysis using deep learning techniques 470
Ajmeera Kiran, Ramesh Babu Jonnalagadda, D. Rabiya Begum, Vikram Neerugatti, J. Somasekar & Mohammed Kashif

Automated solutions for enhanced efficiency in poultry production 476
D. Ram Nivas, T. Ashwath Kumaran, M. Haribalasubramaniam, V. Aravinth & E. Ajay

Automated tomato disease detection and classification using image processing and machine learning for precision agriculture 481
Priyanshu Patwal, Rahul Chauhan, Chandradeep Bhatt & Swati Devliyal

Bioleaf AI: Unravelling plant leaf diseases with AI-Powered classification 487
Ashutosh Kumar, Manjinder Singh, Sagar Singh, Sumit Kumar Bhagat & Satwik Raj

Detection and reporting of wildfires in forests using a wireless sensor network 493
Reddyvari Venkateswara Reddy, R. Vijay Anandh, Gaurav Vishnu Londhe, G.D. Vignesh, Priyank Purohit & Vuda Sreenivasa Rao

Empowering agriculture with AI: The smart agrohub initiative 499
P. Uma, M. Gomathi, K.P. Gokulkumar, T. Monika & P. Preethika

Enhancing weather prediction and forecasting for agricultural applications using machine learning 506
Bipul Biswas, Rehan Khan & Yogesh Thakare

Plant leaf disease detection by deep learning algorithm 512
Mundluru Dharani, D. Nagadevi, Kumpatla Harika Sai Durga, Anusha Basamsetti & Kavalipurapu Chandra Sekhar, T. Venkatakrishnamoorthy

Smart health monitoring system using IoT and machine learning 518
S. Thangam, M. Gurupriya, A. Adithya Vardhan & Maganti Akshita Uma Sai, Yelleti Manikanta Praneeth Kumar

The role of artificial intelligence in computer-aided drug design 524
Amrita Verma Pargaien, Amita Joshi Rana, Bhawana Chilwal, Rajat Dumka, Diya Jeena & Heena

Using machine learning algorithms to predict crop production and recommend fertilizer 529
Rahul Chauhan, Chandradeep Bhatt & Swati Devliyal

Yolov5-based human and animal detection using a rescue drone 534
Shraddha Kaparwan, Sanchit Negi & Ganga Negi

Industry 4.0 and 5.0

AI-optimized electrical wiring harness design for automotive applications (Connector selection) 543
C. Gopinath & M. Thenmozhi

Improved quality control techniques in manufacturing sector through image anomaly detection in industry 4.0 550
K. Hema Latha, Manoj Govindaraj, Kolli Veena, Santosh Karajgi, Hariprasad Tarigonda & N. Tulasi Radha

Industry 5.0 and the AI/ML Era: Revolutionizing manufacturing 557
Mageshkumar Naarayanasamy Varadarajan, C. Viji, N. Rajkumar & A. Mohanraj

Industry 5.0: The human-centric future of manufacturing 562
N. Rajkumar, Balusamy Nachiappan, Ann Mathews, V. Radha, C. Viji & Judeson Antony Kovilpillai

Machine learning-driven predictive maintenance for enhanced production management in the manufacturing industry 568
K.T. Thilagham, A. Basi Reddy, E. Devashree, Gopala Rao Thellaputta, R. Dharan Kumar & Kowdodi Siva Prasad

AI, ML, and data science

A comprehensive study on the harmful effects of the smoking on human beings 577
S. Gupta, Vijay Kumar & Priyanka Gupta

A comprehensive survey on the emergence of computer science in biotechnology 583
Soni Pathak, Rahul Chauhan, Swati Devliyal & Chandradeep Bhatt

A deep dive into the computer virus and its detection algorithms 589
Aakash Manna, Rahul Chauhan & Ruchira Rawat

Advancements and challenges in federated learning: A survey 596
S. Saritha, Kattinti Mahesh Babu, Shaik Seema, Shanmugam Varsha, C. Uma Maheshwari & M.D. Suguna

An automated computerized method for the detection of fire using novel deep learning based method 603
Puneet Nema & Sunil Phulre

An efficient resource allocation using Cuckoo search algorithm 607
Rasinti Lakshmikanth, K. Dinesh, S. Md Sohan, A. Nithish & S. Uday Kiran Raju

An imitation of humanoid robot: A qualitative analysis 613
Gautam Singh Jyala, Rahul Chauhan & Ruchira Rawat

An Insight into the world of Virtual Reality (VR) 619
Drishti Dasgupta, Kanchan Dhanik, Rahul Chauhan & Ruchira Rawat

Artificial intelligence for HR 4.0: A conceptual framework 625
K. Kaushal & K. Kasat

Artificial intelligence role in stock market: A comprehensive analysis 630
S. Gupta, V. Kumar, K. Ahalawat & V. Sagar

Artificial intelligence – the future of education: A review 636
Shweta Arora, Gunjan Bhanwal, Saurabh Pargaien, Akansha Mer & Abhishek Misra

Augmented reality synchronization between devices through On-device QR code 641
Seon S. Kodankandath & M. Mythily

Business analysis using Long-Short Term Memory (LSTM) networks: A deep learning approach 648
Aditya Kumar Dubey, Rahul Chauhan, Ruchira Rawat & P. Parthiban

Chatbot for government schemes using Python 653
N.M. Indumathi, R. Deepan Raj, J. Gopal, P. Goutham & S. Rudhish

Comparative analysis of BERT-Pipelines in SQuAD and MedQuAD question answering 659
V.S. Harikrishnan, N. Abinaya, S. Santhiya, P. Jayadharshini, B. Aarthi & K.N. Swetha Nallamangai

Deep learning algorithms for the detection and categorization of pneumonia in chest X-rays 664
Sangeetha Murugan, R. Kiran Babu & Manjunath Thabjula, D. Tirumala Venkata Srinivas & D. Tharun Reddy

Deep learning insights into seasonal crop mapping: enhancing agricultural productivity through advanced neural networks 669
K. Aadhavan, R.K. Divya, P. Keerthi Krishnan & M. Devaki

Ensembling classical machine learning and deep learning approaches for morbidity identification from clinical notes 675
M. Deepadharani, S. Deetchanya, M. Hemathbhusani, K. Praveenkumar & P. Savitha

Evaluating subjective answers using RNN and NLP 681
R. Manikandan, R.N. Yakshith Sai, G. Vignavi & G. Santhosh Kumar Reddy, N. Sri Dharshani Reddy

Food recognition system using deep learning 687
S. Karuppusamy, P. Sri Senthur Murugan, M. Srinesh, S. Surya & S. Thamseel Ahamed

Handshake between humans and artificial intelligence: A review 693
Shweta Arora, Mamta Pawar, Mayank Joshi, Saurabh Pargaien, Akansha Mer & Abhishek Misra

Handwritten recognition system using deep learning 698
Nandan Singh Khani, Chetan Pandey, Amit Juyal, Aditya Harbola, Devvret Verma & Rashmi Verma

House price prediction using machine learning 704
P. Sobana, M. Balakumaran, S. Bharathkumar, P. Boopathi & J. Harish

Leveraging YOLOv8 for ear detection in biometric systems 709
Niharika Singh, Archana Bamal, Tanishka Mehra & Ela Kumar

Machine learning for real-time stress analysis in IT team 714
N. Balakrishna, K. Vidhyavathi, S. Khwaja Moinuddin Basha, T. Rajasree, P. Vinitha & C. Gnanaprakash

Peer to peer confidentiality in networking 720
Brahmi Bora, Rahul Chauhan, Sagar Giri & Ruchira Rawat

Prediction of modes of child birth using SVC 726
P. Devika, S. Bhuvaneswari, R. Rithika, S. Swarna & N. Vijitha

Predictive modeling of academic success using extreme learning machine 732
Muvvala Viswakiran, S. Padma, Gundloor Shaik Sameer Hussain, Afkhan Suhail Khan & Jampala Reddyprasad Naidu

Psychological capital as a predictor of work-related outcomes: In-role performance and organisational citizenship behaviour 738
K. Sindhura

Securing precision and adaptability: A comprehensive study on BERT-enhanced sentiment analysis and robust administrative access control in product review systems implemented with node-RED 743
Y. Indira Priyadarshini, Shaik Ruqsar Begam, Mangali Pujitha, Pullipati Divya Sudha & Punati Bhargavi

Unmask the fraudulent: Real-time detection of fake instagram profiles with enhanced transparency using LIME interpretable 749
S. Aslam Shareef, Polipalle Sai Charitha, Kaluburigi Sravani, Nara Sruthi & Ganda Maheswari

UPI fraud detection using machine learning 755
S. Jagadeesan, K.S. Arjun, G. Dhanika, G. Karthikeyan & K. Deepika

Utilization of machine learning techniques for the early prediction and management of lung cancer patients 761
Bechoo Lal, N. Ashwini, CH Srilakshmi, Anupam Singh, Narender Chinthamu & Manjushree Nayak

Emerging technologies using computing methodologies

An investigation of ethical hacking: White-hat hackers 769
Rahul Chauhan, Rajat Singh, Ragini Bartwal, Ruchira Rawat & R. Dhanalakshmi

CyberShield: A secure system initiative for safeguarding user data 775
S. Palani Murugan, S. Aravindha, K. Madhumitha & M. Mohamed Ismayil

Development of energy energy-efficient wireless communication network using green 6G with edge computing 780
J. Geetha Priya, S. Parameswari, AshishBandaru Purna Shashanka Sai, Vrince Vimal & Bhimasen Moharana

Encrypted mail communication using AES algorithm 786
Shilpa Jain, Vinny Kapoor, Yash Vardhan Pant, Shyam Yadav & Ashish Garg

Management and deployment of 5G small cells and HetNets using deep learning 792
K. Vijayakumar, AshishVrince Vimal, Ali Kareem Obaid, R. Anil Kumar & Parminder Singh

Self-rinsing commode system 799
T. Shanmugaraja, B. Priyadharshini, E. Sam Chriswin, S. Selvamuthukumar & R. Sidharth

Shape: Machine learning model for early fish disease prediction by checking water quality 804
Kattinti Mahesh Babu, G. Prashanthi, T. Manasa, B. Pranathi & G. Akshaya

Technology-driven facilitators for sustainable tourism: A case study of Rishikesh, the yoga capital of the world 810
Lata Pande, Urvashi, Santoshi Sengupta & Vinay Kandpal

Under graduate programme PO and PSO attainment Deep learning 816
S. Manikandan, G. Lakshmi Vara Prasad, S. Nandhini Devi, D. Nageswara Rao, R. Gopi & P. Dhana Lakshmi

Specific topics

Deepfake detection using fine-tuned VGG16 model: A transfer learning approach 825
Aditya Vikram Singh, Devshree Moghe & K. Meenakshi

Enhanced SAR automatic object identification using residual inaccuracy CNN and PCA magnitude downsizing 830
Mehul Manu, Kashish Mirza, Saurabh Dhanik, Rashmi Deopa & Shewta Goyal

Formation of centre for computing skills & career development (CCSCD) under graphic era society, Bhimtal Campus, Nainital (Local youth empowerment initiative) 836
Asheesh Sah & Manish S. Bisht

Impact of channel tapering on threshold voltage variation in multi-layer word line 3 dimensional NAND structures 842
Dikendra Verma, Upendra Mohan Bhatt & Anurag Vidyarthi

On-chip assessment procedure and calibration structure for aging durability assessment of integrated circuits 848
Mehul Manu, Saurabh Dhanik, Kashish Mirza, Rashmi Deopa & Shewta Goyal

Sign language recognition model 855
Elina Singh, Aditi Balaji & K. Arthi

Unravelling the power of AI: A comprehensive comparison of nutritional status – BMI and AI Tools 861
Ritu Dhami, Sukanya, Pratiti Haldar & Devyani Rawat

Author index 865

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Preface

In an era defined by rapid technological advancement, Information, Communication, and Computing Technology (ICCT) has become the backbone of modern society. These interconnected fields drive innovation, shape economies, and influence every aspect of daily life, from how we communicate and access information to how businesses operate and governments function. However, with these advancements come significant challenges that require thoughtful consideration, innovative solutions, and ongoing research.

This collection of papers addresses some of the most pressing challenges in ICCT. The contributors to this volume explore a range of topics that are at the forefront of current academic and industry discussions. As the digital world expands, so do concerns about the security of data and the privacy of individuals. This section delves into emerging threats, from cyber-attacks to data breaches, and discusses strategies to mitigate these risks. The explosion of data generated by various sources poses both opportunities and challenges. Effective data management and analytics are crucial for extracting meaningful insights, yet the sheer volume and variety of data present significant technical and ethical challenges. The infrastructure that supports global communication is constantly evolving. With the advent of 5G and beyond, this section examines the challenges of building robust, high-speed, and reliable networks that can meet the demands of an increasingly connected world. These technologies are transforming industries but also raising questions about ethics, bias, and the future of work. This section explores the balance between leveraging AI's potential and addressing the societal implications of its widespread adoption. As the boundaries of classical computing are pushed, quantum computing presents both revolutionary opportunities and formidable challenges. The discussion here focuses on the current state of quantum computing and the hurdles that must be overcome to realize its full potential. The environmental impact of technology is an increasingly important concern. This section addresses the need for sustainable practices in computing and the development of energy-efficient technologies. By bringing together diverse perspectives from experts in these fields, this volume aims to provide a comprehensive overview of the challenges facing ICCT today. It also seeks to inspire new ideas and approaches that will help overcome these challenges and pave the way for future technological advancements.

We hope that this collection will serve as a valuable resource for researchers, practitioners, and students alike, providing insights that will inform their work and contribute to the ongoing evolution of Information, Communication, and Computing Technology.

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Accident detection and human rescue system

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ABSTRACT: In today's urban regions, the number of traffic accidents has climbed to an unsettling level. Accident-related fatalities will be decreased. Lack of communication is the key issue leading to the loss of life. Under this project, the hospital and accident site will be in communication. This project recognises an accident, notifies the closest ambulance via the 108 service using a GSM module, and gives the victim's contacts the information. The patient's fundamental medical circumstances are sent by the ambulance to the closest hospital, and the patient's health parameters are continuously sent to the hospital by the ambulance's patient monitoring system. The hospital's monitoring system receives the information, and the doctor can use it to diagnose the patient and perform the appropriate pre-hospital action. Due to the systems complete automation, it can locate the accident site and aid in a timely arrival at the hospital. The data is sent to the hospital's monitoring system, which the doctor can then use to diagnose the patient and take the proper pre-hospital action. This technology locates the accident location and helps with prompt hospital arrival because it is completely automated.

Keywords: Global Positioning System (GPS), Global System for Mobile (GSM), Microcontroller, Heart beat Sensor, Vibrator Sensor, IoT

1 INTRODUCTION

The World Health Organization estimates that each year, automobile accidents cause 20–50 million injuries and nearly 1.35 million fatalities worldwide. Particularly, a certain percentage of fatalities and injuries are the consequence of delayed medical care and subsequent accidents, which arise when the emergency services and nearby vehicles are unable to get prompt information about the collision [1,2]. Finding anything or anyone is becoming more and more challenging in the modern era as the world's population continues to grow. On the other hand, the increased demand for cars has made traffic problems and accidents on the roads worse [3,4]. The whole public is in great risk. Most fatal accidents worldwide result from road traffic collisions. Finding the accident might not be enough to aid in rescue [5]. The condition of the passengers' or accident victims' health needs to be examined [6].

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There are numerous sensors available to collect data about people's health. Human wearable sensors may transmit data on a person's heart rate, blood pressure, breathing, eye blinking, and other bodily functions [7]. We can evaluate the impact of the accident and, as a result, better comprehend the situation if we study this health data combined with vehicle mounted sensor data [8]. An injured crash victim may die every minute they are not given prompt medical attention, according to research [9].

As a result, the idea of saving lives by fixing the issue is born. Provide an autonomous vehicle accident detection system for this project [10]. This technology can recognize car accidents much more quickly, and it will send a collision alert signal to the built-in mobile number (saving squad, family members, etc.) to help safeguard critical life. They are made up of an MPU-6050 module that recognizes abrupt angle changes that could be signs of an accident. The GSM system is used to send the signal, and the GPS module is used to determine where the accident occurred. In any conditions, it is feasible to track a vehicle [11]. With the use of this technology, poor emergency response times for car accidents can be resolved as effectively as feasible. The accuracy of accident identification based just on speed and acceleration may be limited due to the complicated and unpredictability of the vehicle operating conditions prior to auto accidents. However, they place an undue reliance on vehicle monitoring and communication technology, which is susceptible to failure or damage under certain severe conditions like a thick canopy, an underground tunnel, or serious auto accidents [12]. The conventional approaches use acceleration and velocity, two metrics of vehicle motion collected by vehicular GPS systems, to identify car accidents. The performance requirements for accident detection, however, cannot be reached by current approaches based on a single type of feature in terms of accuracy and speed. Internet of Vehicles and Cooperative Vehicle Infrastructure System have developed quickly in recent years as a result of advancements in computer and communication technology. The creation of a system shouldn't be a one-time task. That ought to keep getting better. In order to perform better in the future, it should draw lessons from its experience and the criticism provided by the subject matter experts. A learning module for required architecture is necessary to learn from and get better at. Building design requires taking into account all of these factors. The appropriate technology must be selected for execution [13].

2 LITERATURE SURVEY

From the literature survey Baseem Almadani, Elhadi M.Shakshuki has given the prototype but there is delay in the communication of data due to system [14]. Nejdet Dogru, Abdulhamit Subasi has given the app that rescues the people from the accident, he proposed method such that the driver phone contains the application in his mobile,as it is an mobile application the driver will be in between as a mediator which is not so helpful and some disadvantages of switch off of mobile phones is seen [15,16]. Fizzah Bhatti, Carsten Maple has proposed the system similar to Baseem Almadani, Elhadi M Shakshuki, we can see the delay in system. The final paper by Karthikeyan M, Manesh V S has Proposed system, which always connected to the Bluetooth which in turn becomes a problem [16,17].

3 PROPOSED METHOD

The suggested system is made up of four parts that work in tandem to ensure that the ambulance arrives at the accident scene and hospital without delay.

The following units

- Vehicle Unit
- Ambulance Unit
- Traffic Unit
- Hospital Unit

3.1 *Vehicle unit*

The vehicle unit as shown in Figure 1 installed in the proposed system's vehicle that detects the collision. When an automobile was in an accident, it immediately sent the location of the accident to the main server. The main server not only determines the quickest path from the accident site to the hospital, but it also notifies a nearby ambulance and relays the information to the traffic unit through RF link. Every vehicle should have a vehicle unit installed in order to carry out this job. It includes a microcontroller, an accelerometer, a GPS module, a GSM module, and sensors to detect accidents. Information regarding the accident is sent to the main server upon impact with the car. The location of the accident as determined by the vehicle's GPS module makes up this information. The GPS system determines the vehicle's current position (latitude and longitude), which is the site of the accident, and provides that information to the GSM module. The GSM module transmits this data to the primary server.

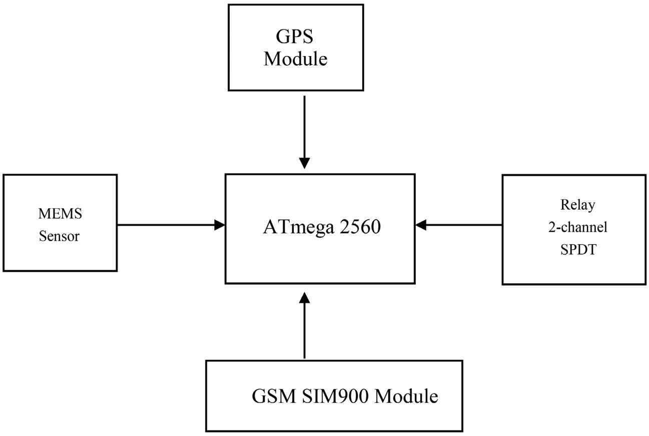

Figure 1. Block diagram of vehicle unit.

3.2 *Ambulance unit*

The ambulance is sent by the control unit to the scene of the accident. The sufferer is taken by ambulance from the scene of the accident. The patient's temperature and pulse rate are continuously measured and transmitted to the relevant hospital while they are in the ambulance. Our temperature sensor is the LM35, and its output voltage is linearly proportional to the Celsius (centigrade). We are employing an IR-based obstacle sensor to measure pulse rate. Usually, traffic delays prevent ambulances from arriving at hospitals on time (Figure 2).

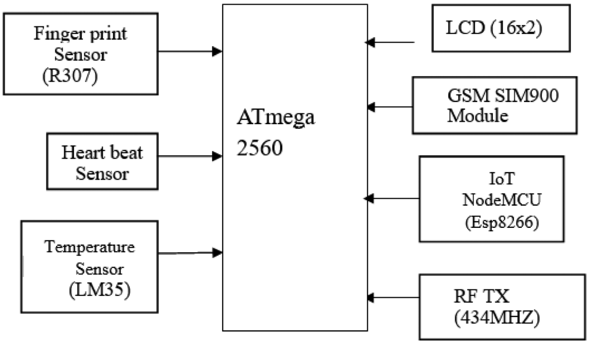

Figure 2. Block diagram of ambulance unit.

The traffic signals along the ambulance's path are managed through RF communication to avoid this delay. An RF transmitter is used in the ambulance portion, and an RF receiver will be used in the traffic unit. The emergency room area when the ambulance is within a 100-meter radius, the RF transmitter aboard the ambulance will interact with the RF receiver of the signal section and turn the signal green. As a result, the ambulance will have an open road to the hospital the entire time, free from any traffic jams [18].

3.3 *Traffic unit*

In traffic section as shown in Figure 3, we use RF receiver depending upon the frequency that we set the range of receiving and transmitting takes place. The RF transmitter and receiver module we are using here is about to give a max range of 300 m, but by connecting it to the external antenna we can extend it up to 28 miles (with high gain antenna). As the ambulance section contains the RF transmitter, it transmits the signals and at receiver end in the traffic section light turns to green when it receives the signal [19].

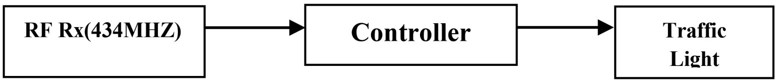

Figure 3. Block diagram of traffic unit.

3.4 *Hospital unit*

In hospital section (Figure 4), we use an IoT based interface. All the nearby hospitals alerted about the accident, the hospital which accepts only gets the patient details and continues monitoring. As in the ambulance section sends the vitals like heartbeat, respiratory details to the hospital through the IOT. The hospital makes the necessary bed arrangement and alert the doctors about the situation in advance, the doctors can analyze the situation well in advance before the arrival of the patient [20]. A close-up of a pile of electronic components on a table is comprising circuit boards, wires, and connectors as shown in Figure 5.

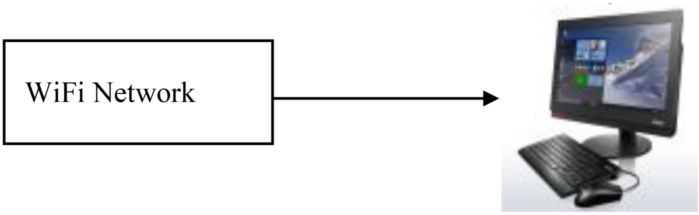

Figure 4. Block diagram of hospital unit.

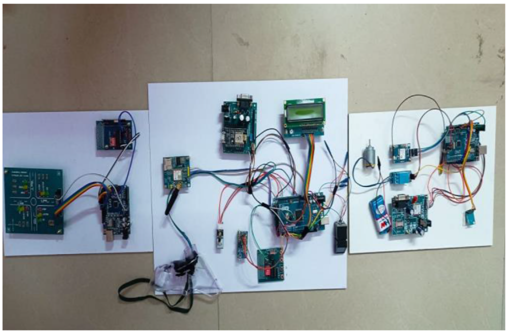

Figure 5. Prototype.

4 RESULT

The below is the kit prototype (Figure 6) we designed of three different sections and we can see the output results in the phone of victims, emergency services and hospital with the requirements [21].

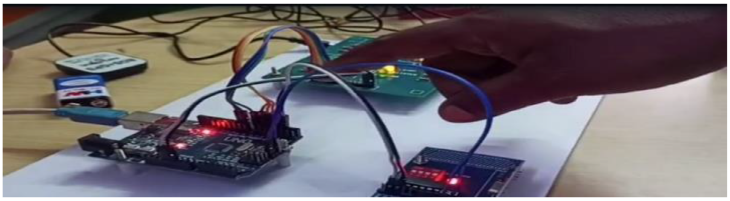

Figure 6. Live stimulation of prototype.

Figure 7 shows the Circuit board with a battery, remote control, and USB cable.

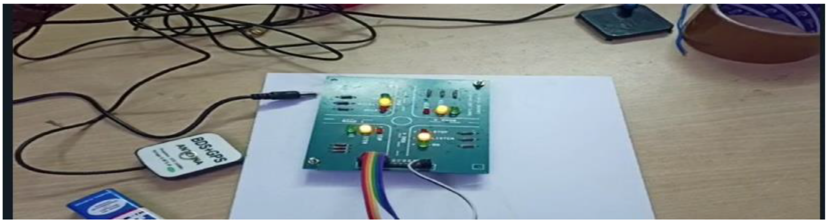

Figure 7. Live stimulation of prototype.

5 CONCLUSIONS

As the population has grown, so has the number of automobiles on the road. An increase in traffic on the roads has also increased traffic congestion, traffic jams, noise, etc. With the aid of cutting-edge technologies, a wide range of applications for traffic management and road safety have been developed. Notwithstanding these applications, if a car accident occurs on the road, many valuable lives could be lost owing to a delay in medical care. For an automatic accident detection and rescue system, an architecture and design methodology are suggested. The appropriate authorities will be informed of the accident scenario after its detection and impact have been evaluated, and the appropriate automatic action will then be started. Several lives are saved thanks to the suggested procedure, which is also simple to use and reasonably priced as a whole. The GSM module and GPS are the main elements in identifying the accident; these elements send the location of the car to the ambulance system, and the status of the patient is tracked in the hospital through communication using this manner. It is intended to save lives in this manner.

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AI based framework for automatic vehicle number plate detection

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ABSTRACT: Two wheelers are often preferred on cars because of their cheapness and fuel economy. The least expensive two-wheel vehicles are generally and frequently used by teenagers by a wide margin. While most people will tell two wheel drivers to wear a helmet, it's the highest ignored advice that guarantees that an injury or death will follow. No one is allowed to ride a two wheel motorbike without a helmet. To reduce head injuries and deaths, the road safety law was created that requires a rider, as well as those who are on a motor vehicle, with a rider on a two wheeler, to wear a helmet as company rules state Drivers of motorcycle commercial violations are mostly investigated by the police in the current method using CCTV narrative. The law enforcement agents proceeded to identify the vehicle registration numbers of non-helmet riders by crawling into every frame of the video recorded by CCTV. It will require an enormous amount of time as well as human effort. The proposed technique scans immediate time video data through cameras installed at key areas, like corners and roadways, using object recognition and machine learning to identify motorcyclists who are not wearing headgear. This is anticipated that the suggested approach will substantially decrease the percentage of motorcycle crashes that lead to fatalities and serious harm by lowering the amount of non-headgear riders.

Keywords: Automated License Plate Identification, Helmet detection, OpenCV, YOLOv5

1 INTRODUCTION

Due to its affordability to people from a wide range of socioeconomic classes, two-wheelers vehicles are currently the most efficient and cost-effective choice for them. With a rapidly growing population size, about 75% people in India own a two-wheeler and 25% owns a four-wheeler. The single most important element of a two-wheeler protective gear is a headgear. The World Health Organization (WHO) just issued its 2018 "Global Road Safety Status" study, that states that annually, 1.35 million people dies from traffic-related incidents, including motorcycle riders [6]. Because of their cheapness and fuel economy, motorbikes have become the primary mode of conveyance in certain undeveloped regions, where the traffic fatality rate is nearly three times greater compared to metropolitan areas. In addition, the number of motorcycle crashes caused by irresponsible and reckless two-wheeler drivers is increasing each day. Serious brain injuries from motorcycle riders' who were not wearing headgears are common, this is cause a huge concern. The current camcorder surveillance frames are successful, but their long-term sustainability is hampered by a number of specific factors that affect their effectiveness. A study data shows that serial crimes with fatalities happen too frequently under video tape monitoring [1]. Therefore, involving mortal surveillance will not actually be useful. Mortal bias enters the picture in some cases, such as when police physically reprimand individuals for not wearing helmets, undermining the effectiveness of the system. In order to protect the offenders from unsuccessful circumstances, this method must be automated so that each one is regularly applied. Various countries have installed

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CCTV cameras all over public spaces so as to guarantee an all-round round safety through surveillance 24/7 [17] which is the major vision of creating a city that is securely watched. The Government of India as a response to the Motor Vehicle (Amendment) Act of 2019 shifted its attention to the way a mother encourages children to embrace health by threatening to hit them on the hand with a fist when they are disturbed for not obeying. A motorbike rider that knee drags his way between the slow-moving traffic in contravention to section 194(d) liable to pay a fine of 1000 or even a jail term that will come together with getting your licence suspended for three. On the other side will people survive without these laws or just a change with these laws; furthermore, most of the investigations of police officers are complex and expensive hence this will hinder the crime-fighting efforts. So, in this case, a helmet detection device will be needed to be created for motorcyclists, not to just focus on eliminating this reason. The ideal outcome would be to create an inherently smart framework which may be automated to detect issues of this nature at no human expense. We must figure out how to identify the bike and rider from the videotape frames in order to identify the motorcyclists who don't wear helmets. We also need to find the cyclist's head and classify whether or not the rider has on a helmet. We used the YOLOv5 (You only look formerly) method for object discovery, including the two-wheeler, rider, license plate, and the rider's head. OpenCV handles image processing tasks, abetting in landing, manipulating, and integrating with YOLOv5 (You only look once version 5). For classifying images, the Image classifier ResNet50 is used to ascertain if the rider has on a helmet. If the classifier indicates the rider isn't wearing a helmet also it saves the license plate in one brochure and rider filmland one the other brochure. Afterwards, we can utilize Python Optical Character Recognition (OCR) to extract valuable textbook content from the license plate photos we've stored in our pamphlet. That text can be latterly used for generating a challan.

2 RELATED WORK

In this author used background subtraction, adaptive Gaussian modeling, and consolidation of consecutive frame results for enhanced accuracy [3]. "Improved OCR based automatic vehicle number plate recognition using features trained neural network" by Kakani, B.V., Gandhi, D. and Jani, S [15]. The paper proposed deep learning-based helmet wear analysis of a motorcycle rider for intelligent surveillance system [14], also presents an automated system leveraging Gaussian Mixture Models (GMM) and Faster R-CNN for real-time detection of motorcyclists without helmets [13,14], demonstrating efficacy across diverse traffic video datasets and achieved accuracy of 92% [4,5] "Detection of non-helmet riders and extraction of license plate number using Yolo v2 [6] and OCR method."

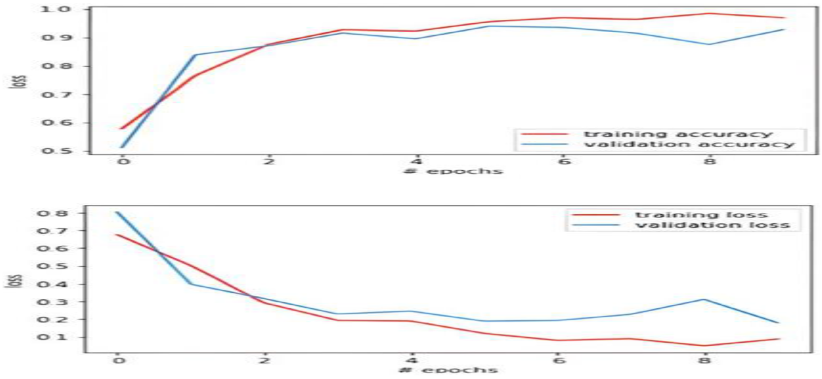
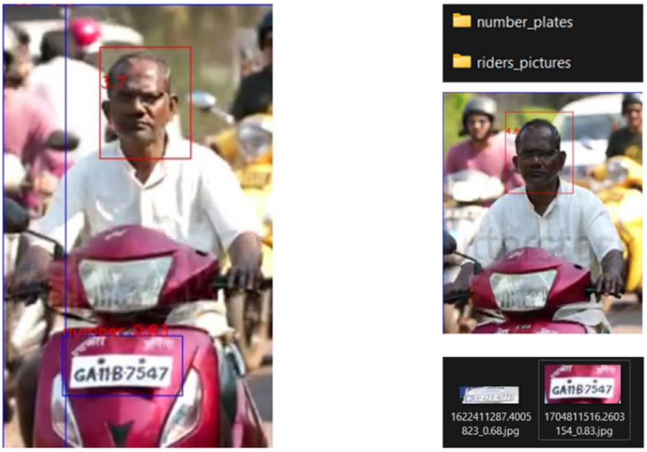


Figure 1. Accuracy plot.

By Prajwal, M. J., *et al.* This paper introduces an ANPR system with YOLOv2. The authors also used OCR to retrieve text from number plates [7]. Desai, Maharsh, *et al.* “Automatic helmet detection on public roads.” The author used Hough transform descriptor, background subtraction for detecting a alcoholic and helmetless rider [8] Machine vision techniques [9] for motorcycle safety helmet detection.” [10]. The system employs background subtraction, connected component labeling, K-Nearest Neighbor (KNN) classification [11,12], low-pass filtering, contour analysis, and feature extraction techniques such as circularity, average intensity, and average hues for motorcycle recognition and helmet detection.



(a) (b)

Figure 2. Detection of rider and number plate and saving the data.

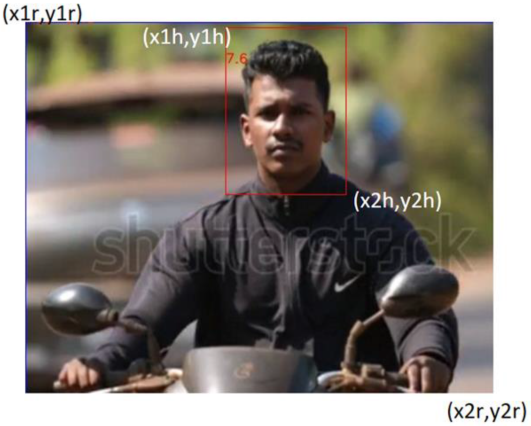


Figure 3. The enclosing box’s coordinates surrounding the object.

3 PROPOSED SYSTEM

3.1 *Objective*

In this paper we are detecting whether two- wheeler rider sporting out helmet or not, if he/she is no longer carrying out helmet then we are detecting and saving license plate of that two – wheeler. To gain descry license plate of motorcycle we're using YOLOv5 model. To follow above style, we're following or fulfilled underneath modules.

(1) First image might be adding to the operation and the exercising YOLOv5 we can check whether or not image incorporates character with motor bike or no longer, if YOLO model descry both man or woman and motor bike also we will do to step 2.
(2) In this module we're suitable to exercising YOLOv5 interpretation to descry whether object put on and tear and incision and gash helmet or no longer, if he wears helmet also operation will stop also itself. Still, also operation do to step three.
(3) In this module we're suitable to descry and prize the number plate in addition to picture of rider in a separate folder which can be further exercised for OCR.

3.2 *Algorithm*

Step 1: Detection of motorcyclist
Step 2: helmet detection (i.e., whether the motorcyclists being spotted are wearing helmets or not)
Step 3: if helmet is not detected then the number plate and the picture of rider will be saved.
Step 4: Stop

4 EXPERIMENTAL RESULT

The datasets for this reflect consideration on were accrued from distinctive sources like robo flow, coco dataset. The datasets had been isolated into 80: 20, in which 80% images are used to train and 20% are used to test our model. An online GPU called Google Collaboratory offers a Tesla GPU with twelve gigabytes of memory. The Python programming language's apps that used the OpenCV package were used to explore the mechanical characteristics of LP motorcycle riders without helmets. Approximately 1001+ datasets have been defined using the bounding field data in order to prepare the YOLOv5 show. The input picture or the video limits of 800 × 480 pixels however we can change the resolution according to our needs. We have selected 200 riders (100 with head protection and 100 without) in order to evaluate the prevalence or cultivation rate of license plate recognition for riders who do not wear helmets in the video. Out of two hundred 100 riders without headgear, about 85 could be correctly identified by the system. In both cases, the assessment cost is moved ahead of ninety due to incorrect instructions. 82 LPs have been found out of 85 riders who did not wear helmets, making the LP detection rate more than 85% if a camera is placed or video is recorded from a particular angle in which our model is trained.

Figure 2 shows the image shows a split view of two scenes with motorcyclists on a busy street, focusing on a particular motorcyclist with a pixelated face for privacy. Tags labeled "number_plates" and "riders_pictures" suggest identification purposes, and an enlarged view of a number plate reads "GA11B7547" with associated numbers below.

Figure 3 shows the image features a person with their face obscured by a pixelated block, sitting behind a cooking pot and holding two metallic utensils, with red rectangles and coordinate labels suggesting spatial analysis in an outdoor setting.

5 CONCLUSION

We have created a computer program that uses CCTV cameras or recorded video sources to identify motorcycle riders who don't have on a helmet. The evaluation's findings demonstrate that the suggested system could identify motorcycle riders who wore caps or hoods by looking at their license plates. The total LP detection rate result for motorcycle riders who did not use helmets was good and accurate. Since the LP is positioned at the front, the system depends on it. These issues can be resolved, and the model's accuracy increased with more research. The input is processed by the OpenCV module, and the resultant frames are shown as a video.

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An integrated mobile solution for smart irrigation management and monitoring with IoT technology

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ABSTRACT: We all are aware of the IoT-enabled popular smart irrigation systems that help in saving resources while increasing yields for agriculture. This paper covers the aspects of creating a mobile solution for irrigation control and monitoring using Raspberry Pi, sensors etc. The sensors gather real-time data, such as; pressure, temperature humidity, various levels of water and use the functionalities on Raspberry Pi to analyze it for activating watering motor via machine learning. For data storage, remote monitoring and manual control as necessary cloud technology has been integrated. Machine learning outputs for motor activation with prediction accuracies of 95.5%, 92.2 cm, and 90% accurate are based on CNN, RNN, and ANN algorithms respectively. The study shows the promise of IoT based integrated systems toward sustainable agriculture and enhancing resource utilization.

Keywords: Precision agriculture, smart irrigation, IoT, machine learning, environmental sensors, crop cultivation, CNN, ANN, SVM, RF, crop yield

1 INTRODUCTION

The agricultural industry is undergoing significant changes due to the need for technological advancement and efficient resource management. With the growing global population, there is a higher demand for food production, leading to the development of innovative agricultural methods that focus on better yields, resource efficiency, and sustainability. One major challenge faced by modern agriculture is the rational use of limited natural resources, particularly water. Smart irrigation systems, enabled by the Internet of Things (IoT), have emerged as a

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solution to this problem. This study explores an integrated mobile solution for intelligent irrigation management and monitoring based on IoT technology. The system utilizes a microcontroller, various sensors, and a central unit such as a Raspberry Pi to optimize water usage, enhance crop well-being, and automate irrigation management. Machine learning techniques, including artificial neural networks, recurrent neural networks, and convolutional neural networks, are employed to predict motor activation and improve irrigation efficiency. Cloud computing is leveraged to store historical data, enabling manual control and real-time monitoring for user-friendly smart irrigation.Intelligent irrigation systems offer a sustainable and efficient approach to watering crops by utilizing data-driven decision-making and real-time monitoring. These systems have the potential to increase yields, reduce water loss, and modernize traditional irrigation practices. The integration of IoT technology in agriculture has expanded the scope of precision agriculture, with IoT devices like sensors, actuators, and communication networks enabling predictive irrigation control and real-time data collection for smart irrigation systems. Key components of intelligent irrigation systems, including microcontrollers, sensors, and central units, play critical roles in ensuring precise and efficient watering. Machine learning models have shown promise in predicting irrigation needs based on historical and real-time data, reducing the need for reactive systems. Cloud computing plays a crucial role in storing, analyzing, and monitoring data for smart irrigation, facilitating user control, accessibility, and information management. Evaluation metrics such as precision, accuracy, recall, and F1 scores are essential in assessing the performance of smart irrigation systems and their implications for plant health and water resource management.

2 METHODOLOGY

The suggested smart irrigation system (Figure 1) is a complete solution that effectively monitors and controls agricultural irrigation activities by utilising a number of components. This system gathers field data in real time and uses sensor readings to make reasoned decisions in order to maximise the use of water. A Raspberry Pi, a pump, and various sensors—including ones for temperature, pressure, moisture, humidity, and water level—are the main parts of this system.

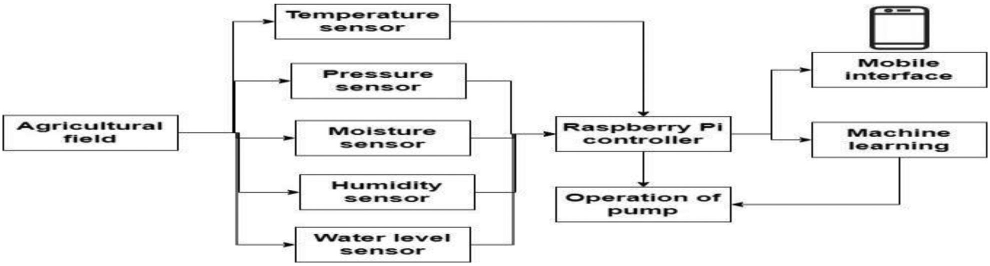

Figure 1. Architecture of the system.

The process flow of information and decision making is explained thoroughly. The methodology of the system is given below; Among the architectures is a network of sensors deployed across the farm that gathers important environmental data related to crop maintenance. Pressure, Temperature, Humidity and Water level sensors help in monitoring different conditions and with the real-time data streams available it makes take faster decisions on when to start irrigation. Once this data from sensors is collected, it's processed by the microcontroller, and sent off to the chief decision-making unit: The Raspberry Pi. Raspberry Pi is used to compare sensoric data with pre-defined standards, regulating the optimal growth environment: water only if low humidity of soil and not more than sustainability.

That's a huge step towards automating and making water use more efficient, not to mention decreasing the need for manual work. Moreover, it also uses the cloud services and saves the data. Decisions logs and field data are easily saved in it so that for future the system can use these records to interpret anything. Since the cloud technology helps remotely monitor and manage crop statuses, farmers have complete freedom to take control of irrigation manually according to their understanding or observation on fields. It improve resource management and support in practice of sustainable agriculture.

3 VARIOUS COMPONSENTS OF IOT SYSTEM

The objective of this study is the development of an IoT smart sensor system for agro-based irrigation assisting to attain water use efficiency and ensure good health of crops in agricultural fields. The system contains Raspberry Pi which processes the data and decides further, microcontrollers for transferring of data among them and sensors to sense environment factors such as temperature, pressure, moisture, humidity and water levels. They would provide data realtime to our microcontroller and Raspberrypi which can take decisions accordingly with respect the irrigation. The pump will be used to deliver water for the crops depending on the sensor data as said above, so that right amount of water should reach at 8the right time to a crop. Apart from that system is included the cloud technology which will maximize remote data acquisition and storage for farmers, to reflect on a crops health as well as trends analysis over a time period. The mission of the system is to save water by automating irrigation while allowing manual control where operational imperative. The IoT smart sensor system can enhance agricultural irrigation practice and support harvest maximizing via these components and technologies.

4 RESULT AND DISCUSSION

In the first type, an intelligent irrigation system optimizes crop growth by using real-time data from field sensors. Humidity, pressure and temperature sensors to monitor water level as well as crop conditions feeding this data to a microcontroller for further analysis. The exact set-up, presented on a Raspberry Pi, utilizes an electric pump to wet the crops as per requirement. The real-time performance is recorded in Table 1 that represents sensor readings and user responses. This device can also fine tune the water current to acclimate with changes in day. Request: User can be on the facility of modification based on schedule of watering. At the end of the day, what I want to achieve with all these is an efficient way of watering something by combining sensoring data, micro controlling communication and actions for more green life's.

Table 1. Sensor and actuator response.

Time	Temperature (°C)	Moisture (%)	Humidity (%)	Pressure (kPa)	Actuator Response
10:00	83.8	35	60	101.3	Water On
11:00	84.2	32	62	101.2	Water On
12:00	86.4	28	58	101.1	Water On
13:00	88.7	24	55	101.0	Water Off
14:00	89.6	22	52	100.9	Water Off
15:00	89.2	26	54	101.1	Water On
16:00	87.6	29	56	101.2	Water On
17:00	85.1	33	59	101.3	Water On
18:00	83.8	34	61	101.4	Water Off

The mobile display's visual representation of the smart irrigation system's data and functions is demonstrated in Figure 2. The heart of our research lies in training machine learning models such as Convolutional Neural Networks (CNN), Recurrent Neural Networks (RNN) and Artificial Neural Network (ANN etc.) using the properly archived environmental data to determine the optimal time for watering crops. By this way, a predictive model can get installed to reduce the chances of overwatering mitigating the risk and ensuring 100% accurate watering leading water use efficiency improvement, better crop health and in turn more sustainable agiruculture. It was observed from the study that pollutant CNN has maximum accuracy of 95.5%, RNN's accuracy is 93.4% and then ANN get the lowest result with atmospheric ammonium nitrate concentration prediction by irrigation occurrence year, respectively (Table 1) For assessing the models' performance, accuracy, recall, precision and F1 score metrics were used. The CNN model performed significantly better than RNN and ANN in each metric: Sustainable agriculture, avoiding overwatering of fields and the optimal utilization of water resources all will require that models should be able to accurately prescribe times for when irrigation should occur These machine learning models help to improve agricultural practices and, more importantly, save water resources by providing high accuracy rates. Figures 3a and 3b shows the accuracy of the machine learning models and performance score of the each model.

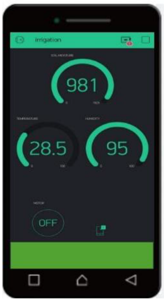

Figure 2. Mobile application developed in this research.

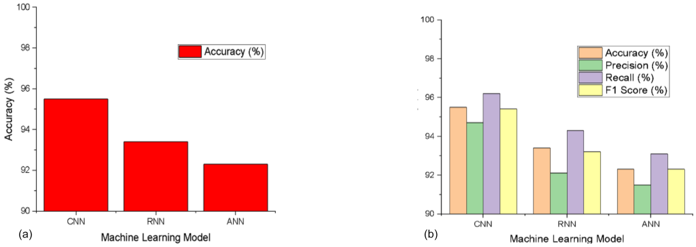

Figure 3. (a) Accuracy of the machine learning models. (b) Performance score of the each model.

5 CONCLUSION

The current study concludes that convolutional neural networks (CNN), recurrent neural networks (RNN), and artificial neural networks (ANN) are machine learning models with a great deal of potential for changing intelligent irrigation systems. The study has shown how these models can predict when to activate or deactivate an irrigation motor in advance with high accuracy, precision, recall, and F1 scores by meticulously gathering and analysing environmental data over the course of a month. Even in our hypothetical example, the results show how effective these models are at maximising crop health, reducing the risks associated with over-irrigation, and managing water resources optimally—all of which lead to more productive and sustainable farming practises. The use of machine learning in irrigation systems seems to be a promising and forward-thinking strategy, promising to significantly improve crop yields, reduce resource waste, and ensure the long-term viability of agriculture in a changing world, as the agricultural industry struggles with the growing demands for precision and resource conservation.

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An IoT sensors enabled smart car parking system

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ABSTRACT: With the fast growth in urbanization and the growing number of vehicles on the roads, systematic car parking management has become a critical challenge in modern cities. Traditional parking system results in congestion, wastage of time, and increased pollution due to drivers for prolonged search for available parking spaces. To address these issues, this research paper presents a smart car parking system (SCPS) that strength advanced technologies to optimize parking slots utilization and enhance the overall parking management. We can solve this problem using Internet of things (IOT). We can easily access the Internet of Things from the Internet station. The system can monitor the parking lot. From depositing to withdrawing, everything is done. Here we are making an IOT based car parking using Arduino nano, IR sensor, LCD screen and servo motors. Infrared sensors are used to control vehicles at entrances and gates, and infrared sensors are used to protect parking space. Servo motors are used to open and close the entrance door according to the sensor. The LCD screen is used to display information such as parking space. All these details that contains information like available slot, filled slot, payment and all are shown in the mobile app. This system helps us to solve many problems like huge traffic jams. Also reduce time and it is cost effective. With this system there is a fire detection system also that automatically senses and alerts the user.

Keywords: car parking management, IoT, Arduino Nano, IR sensors, servo motors, mobile app, traffic congestion

1 INTRODUCTION

The Internet of Things (IOT) is capable of transmitting data over a network without human intervention. The Internet of Things allows users to use wireless technology and helps user transfer data to the cloud. The main purpose of IOT starts with defining what connects various devices. IOT devices are controlled or monitored by computers on the internet. The Internet of Things consists of two keywords, “Internet” and “Things,” where the internet is a large network of connected devices [1]. The internet allows information to be sent, received, and transmitted with devices. The recent research has highlighted that the problem of car parking is becoming a major challenge, especially in urban and metro cities. The increasing number of vehicles being sold every day has resulted in a shortage of available parking slots in parking areas.

This shortage of available parking spaces means that drivers waste significant amounts of time searching for available parking slots, leading to increased congestion and traffic on the roads [5,6]. In many cases, drivers are forced to park their vehicles on the streets, which further exacerbates the issue of space congestion. During festive seasons and peak hours, it becomes even more difficult to find safe parking areas [7]. With help of advance system, we can offer a better service to citizens wants to park their vehicles into any organization’s areas using IOT. Recent advancements in the development of cost-effective and energy-efficient embedded systems have facilitated creation of innovative applications. These are combined with the progress in sensor technology, have led to deployment of numerous IOT-based systems in cities worldwide for monitoring purposes [1,8].

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1.1 *Existing system*

(A) Surveillance cameras: In Bangalore, 180 intersections are equipped with Pan-Tilt-Zoom cameras that provides real time feeds to TMC, which stores feeds for 15 to 30 days using a 24-terabytes storage solution.
(B) Traffic tracking with GPS: 600 BMTC buses of Bangalore are equipped with GPS devices. This helps with congestions across the road.
(C) The problem is that in the current system does not know whether there is a parking space until the parking slot is reached.

Proposed System: Find parking from anywhere with mobile application. A mobile application will be created to implement the project. This mobile app allows the users to check the parking lot and parking space in advance. Each parking lot will have a controller that can monitor empty and occupied parking spaces. Additionally, this project also implements a fire detection system to alert the citizens about any fire related accidents as well as also implement EV charging slots can help to reduce pollution.

2 LITERATURE SURVEY

Aditya Basu [1] says, that these advanced reservation services plus real-time availability of parking spaces are provided through smart parking systems that collect actual information about the number of slots using low energy technology and mobile phones to predict availability up to 30 minutes beforehand. With parking guidance and analytics, they minimize search-around traffic that diminish urban car emissions, and help designated cities administer parking supply and enforcement against illegal parking. The system is consists of a monitoring/control/display system at the pump and a central monitoring system which communicates the available parking with cellphones for users. While on one hand, challenges such as high implementation costs, sensor accuracy impacted by external factors, and privacy and security concerns needing substantial protection procedures.

Uberaba Vyas, Adarsh Kumar, Vadera Dhaval Haresh Kumar [3,9] This project focuses on developing and implementing an automatic underground car parking system specially designed for residential areas. The main objective is to enhance convivence and security for residents by reducing human interaction in the parking process. The feasibility of the project will be assessed through an economic analysis technique. The automatic underground parking system aims to optimize space utilization and increase the availability of parking spots. This is particularly important in parking is a big problem in big cities, especially in busy areas. This project was inspired by many existing car parks, such as multi-story automated car parks and Volkswagen car parks. The concept model of the parking system is designed to have a capacity of 6 to 24 vehicles in a 32.17 square meter parking area. The parking platform will be driven using a chain and sprocket mechanisms [10]. This reduced working model serves as foundations for future developments and can be utilized in different engineering branches to explore various automation techniques like PLC (Programmable Logic Controller), microcontroller and computerization. It is important to note that the application of this automatic underground parking system is limited to malls or similar establishments that have an underground parking facility. The system's implementation in residential areas would provide residents with a secure and efficient parking solution, freeing up space and reducing parking-related challenges [11]. [2] says, the interesting project can be utilized in shopping malls, hospitals, offices where parking are needed spaces for parking inbound vehicles in an effective manner, and provide an effortless way of handling the parking lots. With the help of infrared sensors and a Raspberry Pi, it shows live slot availability status on entrance thus saving time and effort of the customer. Ultimate parking experience with Automated parking system, Less human intervention, De-congestion, Space utilization/Optimization.

RFID technology [4] has been proposed in several smart parking systems, particularly in the prototype stages. It offers an effective solution for managing permit parking and enables easy tracking of vehicles. RFID works on electromagnetic fields to properly identify objects attached to them. A system that uses RFID technology in its technology. Their system includes a software program that manages and reports changes in the station's state. It allows tasks such as selecting the nearest parking lot and sending notifications to the driver. In another system, the door control is integrated with PC control, access control equipment, RFID system and modular garage. Modular RFID parking management provides flexibility by allowing the exchange of different systems or equipment [12]. The use of RFID technology in these systems enables efficient tracking and management of parking spaces. By leveraging RFID tags and readers, the systems can accurately identify vehicles and streamline parking operations. Additionally, the modular nature of the RFID-based parking management system allows for customization and integration with other compatible systems or hardware [13]. [4] Computer vision have gained significant attention from researchers. This field involves using computers to acquire, process and analyze images for human vision, called computer vision.

The goal is to enable computers to better see and process visual data such as images and video and to track changes in images. In computer vision-based smart parking systems, the typical approach involves analyzing a few frames per second and transfer data to central database. The users can store information about changes in the station. One approach is to utilize CCTV cameras for vehicle detection, determining a car or vehicle is available in the parking lot. Pixel detection is employed to differentiate between vehicle pixels and unoccupied areas using a grayscale threshold. Another type of parking uses CCTV cameras to monitor the parking lot. These cameras are installed in the parking lot and detect the parking lot. However, it should be noted that these methods [14] may sometimes incorrectly detect parked vehicles, leading to inaccuracies. A research project proposed by Bong *et al.* in 2008 point to get car park hold information using a combined approach of image processing algorithms. The motivation behind the project is the desire to find effective solution using image processing techniques rather than sensor-based methods [16–18]. The system, called Car-Park Occupancy Information System (COINS), focused on occupancy values but did not provide detailed information on other parameters. Overall, computer vision-based smart parking systems offer high reliability and accuracy in detecting vehicle presence and occupancy. However, challenges remain in ensuring consistent accuracy, especially in scenarios where precise occupancy values are required. These systems present a promising approach to optimize parking management and improve efficiency in parking areas [15].

3 METHODOLOGY

3.1 *Description*

Once the system setup (as shown in Figure 1) we need to install Arduino IDE (integrated development environment) software. It is an open-source software program that allows users to write and submit code in real time.

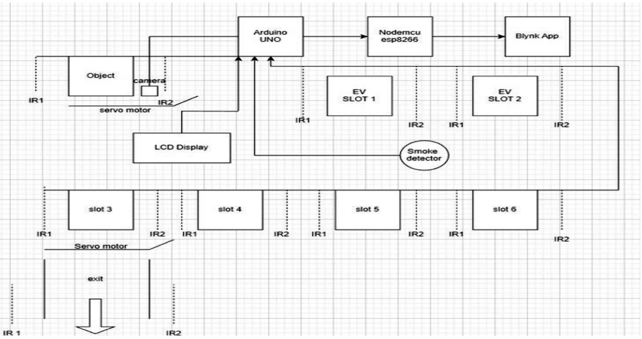

Figure 1. Block diagram.

Here, we will learn how to create an IOT based car stopping, opening, and observing framework. Using Arduino, Nodemcu esp8266. Wi-Fi module and Blynk app. Control the station from anywhere in the world with the help of the Nodemcu esp8266 Wi-Fi module and the Blynk app. We have 4 holes, each with an IR sensor. So, we have in add up to 4 infrared sensors. Each sensor is used to detect the presence of car in the slots. Once, when the object enters in the parking system, so before opening of the barricades it will check whether the object is a car or not with help of camera with the usage of OpenCV python library. After, that will be a car then, the vacancy for the parking slot will be checked with the help of infrared sensors which are located at all slots for the parking.

Starting from the slot number 1 and if the slot 1 is not empty then, the infrared sensors will send the command to Arduino and the Arduino sends command to Blynk App and then, Blynk app display the result will also be displayed on the LCD display screen also then the parking is done according to this:

- And if slots are not available then, we will check for the other slots.
- If all the slots are not empty then also it will be displayed on the Blynk App and the LCD display.
- On the LCD screen available and the occupied slots will be displayed.

4 IMPLEMENTATION

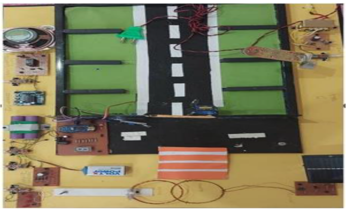

Figure 2. Implementation.

This Smart Parking model as shown in Figure 2 has 8 parking spaces and an entrance and an exit gate. Each station Has a sensor that detects every countable object as it passes through the range. All sensors are connected to Arduino nano devices. Arduino nano kit is related to Node Mcu ESP 8266. The ESP 8266 has sensor instructions from the Arduino IDE. Arduino IDE is a software used for coding. Also, there is an EV charging system and fire detection system using Mq6 sensor to detect the presence of smog and there is an alert system using mini speaker to alert the citizens about fire.

5 CONCLUSION

These days major problem of parking in metropolitan cities is arising because the population get increased and with that number of car holders also get increased and the parking spaces are still limited and some people are also using those parking unnecessarily also and for solving this issue this “smart car parking system” is needed. And as we all know automobiles catches the fire so fast and for the safety of our vehicles, some smoke alerts are also important so for this thing we have used “Photoelectric Smoke Detector” in this project. Like, there are many people who smoke cigarettes and just throw them on the roads in the lit condition and it will cause a big fire. So, if this condition will happen then all the car owners will get notified and they can take their car off from the parking safely. For the better utilization of the parking systems, cameras are installed at the gate which will recognize whether the object that has come is a car or not. Parking costs will also get increased so that only the people who really require that parking space could park their cars over there. So, ultimately this project will help all the drivers who sometimes get unable to find the safe and enough parking space for them. There is a lack of parking and with the use of these kind of parking systems a well-managed parking can be done and we can utilize the parking space also with these kind of parking as these parking will give that space to the cars which is really needed by them. With the division of slots, the cars get parked in a well-mannered way and no car could occupy unnecessary space and with that we can park a larger number of cars in that parking space. So, this project is resolving the parking issue in a better way.

6 FUTURE WORK

- Implement a fully android develop App with user friendly experience.
- Use a new sensor with more distance covering instead of infrared sensor.
- We want to add a payment automation system in our project in which payment for parking could get paid through the fast tags method. As these days, fast tags are common and it is the easiest and less time-consuming way of getting payment from the drivers.
- Integrating navigation system with smart parking can provide users with seamless navigation to available parking spaces. Enabling real time updates whether parking slot is vacant or reserved.
- The smart parking system can be integrated into broaden smart city initiatives, it enables data sharing and collaboration with urban systems. This reduces the pollutions.

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Arduino PulseCraft: Designing your heart's symphony

Lokesh Khedekar, Aryan Bajaj, Arnav Baldawa, Shashank Barge, Yuvraj Bhambare &
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ABSTRACT: At the forefront of innovation lies a groundbreaking project dedicated to pioneering the development of a state-of-the-art Heartbeat Sensor, harnessing the power of Arduino technology. In the realms of healthcare and sports science, the meticulous monitoring of vital signs, including heart rate, is paramount for ensuring individual well-being. While traditional diagnostic instruments such as thermometers and sphygmomanometers have long been relied upon, this endeavor signifies a paradigm shift by introducing a sophisticated Heart Rate Monitor System. The sensor's diverse form factors and instantaneous data retrieval capabilities epitomize a seamless fusion of sophistication and user-friendliness, providing real-time insights into cardiac performance. By offering an alternative to Electrocardiography, this project not only underscores the significance of vigilantly tracking heart rate but also empowers athletes and healthcare professionals with a tool that enhances both efficiency and accuracy in monitoring cardiovascular health. From elite athletes striving for peak performance to patients managing chronic conditions, this sensor offers a portable, yet highly accurate, alternative to cumbersome Electrocardiography machines. As technology continues to advance, this project stands as a testament to the transformative potential of innovation in promoting individual well-being and pushing the boundaries of human performance.

Keywords: Cardiovascular Health, Electrocardiography, Data retrieval capabilities, Arduino technology

1 INTRODUCTION

Cardiac monitoring technologies have greatly advanced modern healthcare by providing real-time heart rate assessments, essential for timely medical interventions [1]. Typically, a healthy heart rate ranges from 60–100 BPM, which indicates cardiovascular health. Technologies like Electrocardiography (ECG), Pulse Wave analysis, Blood Pressure Monitoring, and Phonocardiography have improved diagnostic precision and are now integrated into wearable devices like smartwatches, making high-quality healthcare resources more accessible [2]. Additionally, the use of Pulse Oximeters for measuring oxygen saturation levels has enhanced respiratory health monitoring. The integration of Arduino UNO and the MAX30102 sensor provides an affordable, portable monitoring solution that measures both pulse oximetry and heart rate with features like ambient light rejection, enhancing accuracy [3].These advancements reflect a shift towards accessible, preventive healthcare that integrates seamlessly into daily life, promoting overall health and preventive care [4].

2 LITERATURE REVIEW

Research on Arduino-based heart rate monitors has demonstrated significant advancements in accessible health monitoring technologies. These devices capitalize on the integration of affordable components such as the Arduino microcontroller and optical sensors like the MAX30102, which measures blood oxygen levels and heart rate through photoplethysmography. Studies

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have explored various aspects of these monitors, including their accuracy compared to clinical standards, real-time data processing, and user interface design to facilitate easy interpretation of data by non-experts. The development of such monitors emphasizes not only cost-efficiency but also the customization and scalability of the device for broader medical applications, including continuous patient monitoring and preventive healthcare. Furthermore, research has also delved into enhancing the power efficiency and miniaturization of the device, ensuring it is suitable for prolonged use in everyday settings without sacrificing reliability. The integration of wireless communication technologies has been another critical area, enabling the transmission of data to healthcare providers or mobile devices, thereby supporting remote health monitoring systems. This combination of affordability, customization, and connectivity underlines the potential of Arduino-based heart rate monitors to significantly impact personal and community health systems.

3 METHODOLOGY

3.1 *Introduction to the system*

Heart rate monitoring stands as a cornerstone in the assessment of cardiovascular health, fitness optimization, and stress management strategies. The pursuit of crafting an intricately precise and efficient heart rate monitoring system holds profound promise in revolutionizing health outcomes and nurturing a proactive healthcare ethos [5].

3.2 *System architecture overview*

A distilled depiction of the system architecture elucidates the intricate dance between pivotal components, notably the Arduino Uno, the heart rate sensor, and ancillary elements [6]. This visual elucidation serves as a beacon, shedding light on the intricate pathways of data exchange inherent within the system. An Overview of the system architecture is shown in Figure 1.

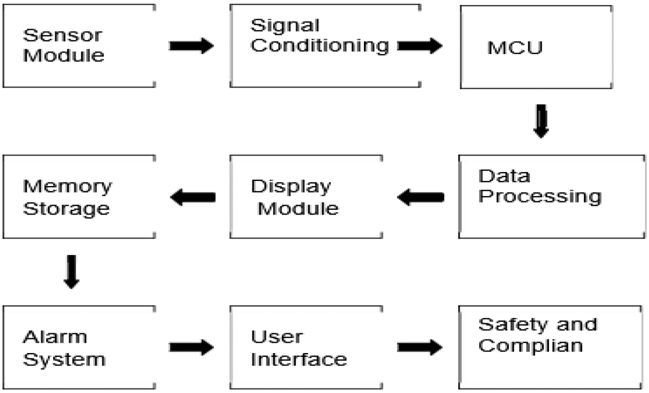

Figure 1. An overview of the system architecture.

3.2.1 *Sensor Module*

Acquires physiological data from the user.

3.2.2 *Signal conditioning*

Signal conditioning involves the utilization of signal amplification and filtering elements to refine the quality of raw sensor data. It essential for optimizing data accuracy, thereby ensuring the delivery of dependable information.

3.2.3 *Microcontroller Unit*

Orchestrates data flow, interfaces with sensors, and oversees overall system operations.

3.2.4 *Data processing*

This involves the analysis of sensor data, facilitating the computation of precise metrics including heart rate and blood oxygen saturation levels.

3.2.5 *Display module*

The Display Module integrates components such as an LCD Display and User Interface whose role involves presenting real-time heart rate and SpO2 values to the user, furnishing a user-friendly interface in heart monitoring.

3.2.6 *Memory storage*

Stores historical data for subsequent analysis and user reference, enabling the retrieval of past physiological trends and facilitating informed decision-making in healthcare contexts.

3.3 *Hardware setup*

3.3.1 *Arduino Uno configuration*

At the nucleus of our heart rate monitoring apparatus resided the Arduino Uno R3 microcontroller, celebrated for its robust computational process [7]. Anchored by an ATmega328P microcontroller operating at a formidable 16MHz, the Arduino Uno R3 boasted a rich array of digital and analog input/output pins, facilitating seamless interfacing with the heart rate sensor and ancillary peripherals [8].

3.3.2 *Heart rate sensor attachment and OLED screen*

Exploiting the principles of light absorption within bodily tissues and vasculature, this sensor discerned subtle variations in light absorption attributed to pulsatile blood flow, yielding an analog signal reflective of heart rate dynamics. In concert with the core ensemble, our system was augmented by the integration of an OLED display, endowed with a 128 × 32 pixel resolution.

3.3.3 *System architecture*

A graphical elucidation depicting the system architecture, encapsulating the intricate interplay among the Arduino Uno, heart rate sensor, and OLED display, offered a panoramic vista of our hardware infrastructure. This architectural scheme served as the cornerstone of our heart rate monitoring ecosystem, underpinning precision data acquisition and seamless real-time display functionality [9].

4 SOFTWARE IMPLEMENTATION

Software essentials include programming, logic, calibration, and critical operational considerations as shown in Figure 2.

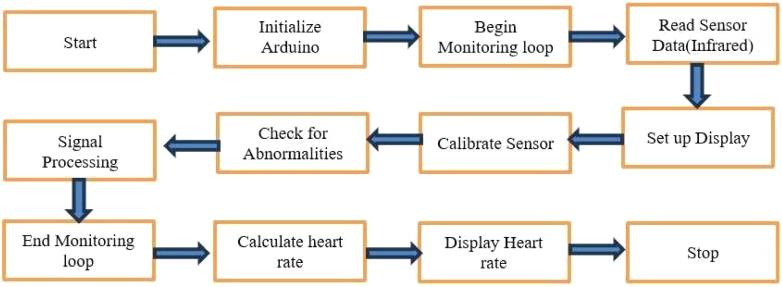

Figure 2. Flowchart of process of calculating heart rate using Arduino.

4.1 *Programming language*

Our software milieu was forged utilizing a dialect of the C/C++ programming lexicon meticulously tailored for synergy with the Arduino Uno microcontroller [10]. This selection was underpinned by the language's intrinsic prowess in real-time computation, innate compatibility with embedded systems paradigms, and the expansive support ecosystem endemic to the Arduino community.

4.2 *Code logic*

Embracing a modular architectural ethos, our software framework harnessed discrete functional modules to choreograph pivotal system operations [11]. The primary execution loop meticulously orchestrated data acquisition from the heart rate sensor, underwent requisite computational processing, and judiciously updated the display interface. Strategic deployment of interrupt-driven routines ensured temporal fidelity during critical data acquisition epochs, thereby preserving system responsiveness and fidelity.

4.3 *Calibration*

In pursuit of the utmost precision in heart rate determinations, our system implements an intricately crafted calibration protocol. Upon system initialization, the software meticulously discerns a foundational baseline value by conducting sensor readings within an impeccably controlled environment. By anchoring subsequent calculations to this meticulously established baseline, our system fosters an unparalleled level of accuracy and reliability in its heart rate assessments [12].

4.4 *Error handling*

A sophisticated filtering algorithm is seamlessly woven into the fabric of our system, meticulously engineered to attenuate noise and harmonize fluctuations inherent in sensor readings. By vigilantly monitoring sensor readings, our system adeptly employs conditional statements to swiftly identify and manage data outliers. In the event of deviation from expected ranges, our system promptly initiates corrective measures or notifies the user, thereby upholding the fidelity of the displayed heart rate data.

4.5 *User interface and optimization*

For user interaction, our system boasts a sophisticated graphical user interface (GUI) showcased on an OLED screen. This intuitive GUI provides real-time feedback on heart rate values, leveraging minimalist graphical elements such as a heart icon alongside numerical displays to optimize user comprehension. User-friendly prompts adeptly guide users through calibration procedures and any requisite actions [13]. Our paramount focus lies in optimizing software performance, striking a delicate balance between precision and the inherent computational constraints of the Arduino Uno.

4.6 *Conclusion of software implementation*

In conclusion, our software implementation impeccably realizes the objectives of the heart rate monitoring system. Calibration and validation protocols, coupled with adept data processing and error-handling mechanisms, significantly bolster the accuracy and reliability of heart rate measurements. The elegantly designed user interface amplifies accessibility. Circuit Diagram of Heart rate monitor is shown in Figure 3.

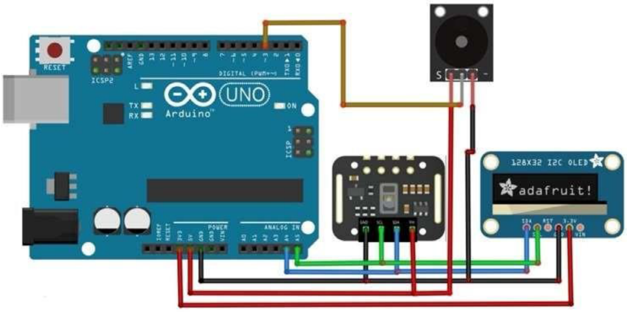

Figure 3. Circuit diagram of heart rate monitor.

4.7 *Validation methods*

Validation stands as a pivotal step in ensuring the accuracy and reliability of the heart rate monitoring system. This process involves comparing the system-generated heart rate data with established standards and conducting empirical validation against clinically validated measurements [14].

4.8 *Data processing*

Data processing is crucial in enhancing the accuracy and reliability of heart rate monitoring systems. Advanced software employs sophisticated filtering algorithms to cleanse raw sensor data of noise and fluctuations, stabilizing the heart rate readings to reflect true physiological conditions accurately. Additionally, the technique of signal averaging further refines the data by smoothing out anomalies and providing a consistent and dependable heart rate measure. This meticulous processing culminates in a user-friendly real-time display that presents heart rate data clearly and effectively, showcasing the system's commitment to precision and user-centric design. This integration of technology ensures a seamless and trustworthy user experience in monitoring heart health.

5 RESULTS AND DISCUSSIONS

In the crucible of our rigorous testing regiment, our Arduino heart rate monitor emerges victorious, a testament to the relentless pursuit of excellence. Through meticulous data collection and analysis, we unveil a revelation of unprecedented magnitude. Four readings per participant (Table 1), distilled into the essence of absolute error, stand as monuments to our system's prowess and precision, casting a radiant glow upon the path of technological advancement. "The product proudly showcases an impressive percentage accuracy ranging from 97.2% to 98.1%, representing a pinnacle of precision and reliability in heart rate monitoring technology."

Table 1. Result of heart rate monitor (In Bpm).

Person	Reading 1	Reading 2	Reading 3	Average Reading	Actual Reading on Heart rate monitors	Percentage error
1	67	68	67	67.33	69	2.41
2	57	58	59	58	59	1.69
3	62	66	65	64.33	65	1.02
4	72	71	71	71.33	74	3.60

5.1 *Technological advancement*

At the zenith of innovation lies the MAX30102 sensor—a paragon of technological evolution and ingenuity. Anointed as the successor to its illustrious predecessor, the MAX30100, renowned for its unparalleled accuracy, the MAX30102 sensor signifies a quantum leap forward in sensor technology. With its expanded memory and augmented library support, this sensor heralds a new era of efficiency and efficacy in heart monitoring [15].

5.2 *Ethical considerations*

In our relentless pursuit of scientific inquiry, ethics stand as the unyielding beacon guiding our passage. Paramount among these considerations is the sanctity of participant welfare and privacy. Robust measures, meticulously crafted, safeguard participant privacy through anonymization and stringent data security protocols. Institutional oversight and perpetual vigilance ensure our unwavering fidelity to ethical standards, safeguarding the sanctity of the research endeavor [16].

6 CONCLUSION

In the apex of our endeavors, we exult in the fruition of a pioneering heart rate sensor and SpO2 monitor propelled by Arduino an emblem of innovation in health surveillance, fitness governance, and individualized healthcare. Through meticulous craftsmanship and unwavering ingenuity, our creation emerges as a herald of technological progression, offering multifaceted utility, unwavering precision, and intuitive operability. Our paramount aim to address the burgeoning interest in health and fitness monitoring has been resolutely realized through meticulous data acquisition and the accessible nature bestowed by Arduino's capabilities. Central to our triumph is the ethos of affordability and inclusivity that permeates our project's essence. By leveraging Arduino's capabilities, we have democratized health monitoring, ensuring universal access to vital health insights regardless of socio-economic status or background.

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Creating and deploying a wearable sensor network system for safety and health applications in the IoT ecosystem

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ABSTRACT: This paper investigates the feasibility of utilizing wearable sensor networks within the auspice of Internet-of-Things (IoT) for early health event prediction and enhanced healthcare management' [2] In total, ten subjects contributed real-time sensor data for BP, temp BP, O2 Saturation and EKG readings. These values are used to train the machine learning models (Apache: Decide Tree DT; Random Forest RF; Support Vector Machines SVM; Artificial Neural Networks ANN) Finally, when the accuracies of models in predicting health response are examined at Table III, it is observed that SVM has become the most accurate model with an accuracy rate of 97.6% and ANN became second with an accuracy rate of % 96,44 (Table II). Moreover, DT and RF also provide a high level of accuracy which were 92.2% and 89.9 % respectively These discoveries, therefore, highlight the importance of machine learning in identifying and managing disorders early thus promoting proactive healthcare by creating individual-specific treatment plans resulting to improved patient outcomes.

Keywords: Machine Learning, Heathcare, IoT system, Real time health prediction

1 INTRODUCTION

The Internet of Things (IoT) has brought a whole new dimension in enabling and promoting applications pertained to the safety and health condition of individuals. Integration of wearable sensor networks is becoming more and more necessary in the context of real-time health-care monitoring system and emergency response system [1–3]. The area of safety and health, on the other hand, is drastically reshaping our knowledge-base and reaction mechanisms with the merger of IOT technology. In this comprehensive analysis of the field, we explore these complex interrelations between wearable sensing technologies and networks to form IOT-based connected worlds for specifically personal safety and healthcare applications. We bring out both the disruptive potential of such technologies as well as dynamism in terms of research and development being undertaken [4,5]. Thanks to the synergistic

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relationship between wearable sensors and IoT ecosystems, novel approaches for collecting real-time health data from patients are also becoming possible. It also means the blood pressure, temperature, blood oxygen levels and ECG (electrocardiogram) can constantly be measured as well. “The vital details provided ensures that any health abnormalities are detected in time” In addition, multiple safety-related wearable sensor network applications (e.g., industrial safety, personal security and disaster response) have demonstrated the benefits of these technologies [6–8].

2 LITERATURE REVIEW

In this review, we explore the wide range of sensors used in these different applications and how they are woven into wearables which currently represent a significant avenue by which real-time data can be acquired. This is where the system derived its true potential; operationalizing wearable sensor networks integrated with machine teaning algorithm can help performed-to-end prediction modelling of health response under extreme emergentailties. We need precise predictive models for proactive health crisis management. These models use sensor data of all forms to detect and correct health anomalies even before they occur_METADATA_RECEIVED:=query:queries:[‘drug’, ‘greece’] In esse, quattro tecniche di machine learning come Random Forest (RF), Support Vector Machines (SVM), Artificial Neural Networks (ANN) e Decision Trees(DT) hanno trovato applicazione per la previsione della salute in uno stadio molto precoce e risposta d’emergenza [9,10]. Wearable sensor network has the tremendous scope of patient outcome improvement and personalizing patient care in healthcare applications. Continuous vital health parameter monitoring offers a proactive way of engaging with healthcare to more easily recognize and address diverse array of medical conditions and to identify abnormalities in patient health. In addition, it is possible for medical workers to take quick and intelligent decisions by using the predictive power of machine learning models [11,12]. Wearable sensor networks are vital for safety applications due to a decrease in risks and an improvement of situational awareness. These gloves help protect workers in hazardous environments, like industrial workplaces, by creating a continuous stream of ‘liveness’ data about the environment and the people within them [6]. It has been used in disaster response to enable us have accurate forecasts and early warning of an imminent catastrophe that ensures timely action to avoid any loss of life as our efforts are coordinated. Considering the various applications, a review of literature is presented that stresses the importance wearable sensor networks have when it involves adverse situations towards human safety [13,14]. Still, given that we’re still only starting to scratch the service on understanding this emerging field. The true potential for revolutionary change of wearable sensor networks in IoT ecosystems appears substantial. The combined forces of our sensor data, machine learning algorithms and real-time communication networks is a game changer for healthcare and safety applications. The sensors, machine learning algorithms and experimental results explored in the aforementioned sections are considered from a comprehensive perspective of applying wireless sensor networks as wearable nodes in an IoT environment for healthcare and safety [15].

3 METHODOLOGY

In this study, within the IoT ecosystem, a wearable sensor network system is investigated for real-time patient health monitoring. Sensors such as temperature, pressure, oxygen and ECG are included that take necessary health parameters. A microcontroller will process the data an interfaced to cloud for storing which can be accessed by authenticated health care professional safely. This remote monitoring allows for the detection of an alarm condition in its infancy. Additional security and privacy are implemented through encryption and processing authentication measures. Alerts and notifications on the prompt lead to earlier alert intervention, which in turn can increase patient safety as well as healthcare delivery efficiency. Architecture of the research is shown in Figure 1.

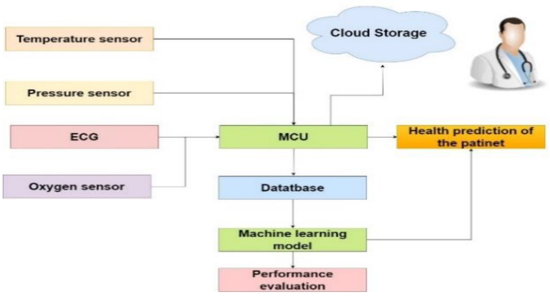

Figure 1. Architecture of the research.

4 VARIOUS SENSORS USED IN THIS RESEARCH

The Internet of Things (IoT) – the connectivity of previously isolated devices and services – has changed the way we communicate and how we can be listened to, seen and attended to, more importantly where we can be attended. Wearable sensor networks are involved with real-time health monitoring and emergency response, collects and records actual vital health parameters as BP, temperature, EKG. Their use case manufactures security and industrial disaster detection far easier. The integration of machine learning with these networks improves the predictability of health responses in emergencies giving a window on how to practice health crisis management. This technology enables real-time data and forecasts support in predicting and improving safety in hazardous environments (wearable sensor networks. In this survey, different sensors, machine learning approaches and related applications in health and security in IoT environment are emphasized.

5 NEED FOR MACHINE LEARNING

Based on the above analysis and evaluation, we suggest that the wearable sensor network system facilitate health monitoring of patients through the fast data generating and flow process for real-time monitoring as well as feedback (Table 3). "At the point of emergency, it can predict and avoid patient's reaction, which will be indirectly helpful in giving fast health treatment without disease. They extend this by utilizing machine-learning-methods (Random Forests, Decision Trees, Support Vector Machines and Artificial Neural Networks) to engage predictive modelling based on real-time health data from used developed mobile sensor networks. And the second are multiple sensors that monitors room temperature, oxygen levels and even ECG (among others) to collect fine grained health data. AI's sub-field, machine learning – algorithms that use data to enable computers to learn from information without being explicitly programmed. Applications span vaccine discovery and predictive modelling in real-time health analytics and emergency services *ANN; SVMs are some of the ML techniques that may handle sensor data to predict or inform about health results. Artificial neural networks (ANNs), designed after the structure of the human brain, is best at identifying complex patterns from data. After which it produces the most accurate health predictions. In contrast, SVM is important when classifying the health response mechanism by helping in classifying the statuses of patients and further delivering a good culture solution for clinical intervention. Yes, Decision Trees (DT) allows us to be transparent while making decisions. Random Forest (RF) extension, which achieves higher prediction accuracy by pooling all individual trees to develop highly accurate predictive models. The integration of such machine-learning infrastructures onto mobility sensor network systems would not only help efficient health systems but may well prove a medical response before it is too late. I strongly believe that this is the convergence of technology and patient simulation that creates a predictive model for personalized medicine with respect to centerline health parameters of individual patients along with his/her clinical history, predictions, medications, and other medical advice. With the given current health information, the patients' answers can be predicted using this system and issues classed to classified so as for healthcare providers emergencies can also be alarmed additionally because of major severity level hence with alternatives treatments recommended. Ultimately, it will help to predict emergencies and health epidemics by utilizing mobile sensor networks alongside predictive models. Only then we can truly optimize our healthcare providers to respond only in places where they are needed most (optimizer).

6 RESULT AND DISCUSSION

Ten subjects' continuous sensor readings are combined into a large database made specifically for this study. These sensor readings include blood pressure, temperature, blood oxygen saturation, and ECG data, among many other health parameters. Database data is used in the development and evaluation of machine learning models. Anomalies in the sensor readings are indicated by deviations from the given health ranges. These variations act as early indicators of potential health issues. Subsequently, these anomalous patterns are employed to train machine learning models to predict potential health problems, such as Decision Trees (DT), Support Vector Machines (SVM), Random Forest (RF), Artificial Neural Networks (ANN), and others. The system can respond proactively to changes in a subject's health thanks to these machine learning models. This predictive approach not only enhances patient monitoring and care, but also demonstrates how machine learning, when integrated with the Internet of Things (IoT) ecosystem, can transform healthcare by providing early intervention and personalised health predictions. In order to evaluate how well various machine learning models predicted health responses, partitioning the dataset into training and testing subsets was a crucial step in this investigation. Seventy percent of the dataset was used for training, and thirty percent was reserved for testing. The objective was to assess the predictive power of different machine learning algorithms using sensor data to predict health responses. The results of the testing phase were particularly insightful and proved the effectiveness of the models which is shown in Figure 2. Support Vector Machines (SVM) emerged as the most successful machine learning model among those tested, achieving an amazing accuracy of 97.6%. This high accuracy suggests that the SVM model did a remarkable job of identifying unusual health patterns and predicting potential health problems. The SVM's ability to create a clear margin between different data classes enabled its outstanding predictive performance.

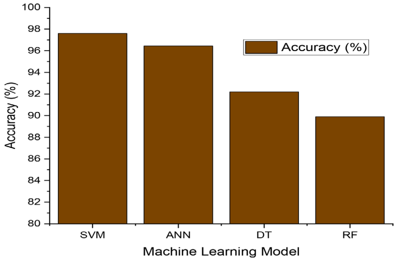

Figure 2. Accuracy of the machine learning model.

Following closely behind was the Artificial Neural Network (ANN), which had an accuracy rate of 96.44%. Artificial neural networks (ANNs) have gained widespread recognition for their capacity to discern complex patterns within data. Their remarkable outcomes in this domain underscore their suitability for tasks that entail health prediction. It was shown that the ANN model could effectively learn from the training set and extrapolate its predictions to test data that had not yet been seen. Furthermore, Decision Trees (DT) generated an astounding 92.2% accuracy rate. Given their well-known interpretability and simplicity, decision trees (DTs) are helpful when the reasoning behind predictions needs to be comprehensible and straightforward.

Their ability to navigate a tree-like structure of conditions and make well-informed decisions proved effective in this context of health prediction. Lastly, even though the Random Forest (RF) model only produced an accuracy of 89.9%, its predictive power was greatly increased. RF is an ensemble learning technique that combines multiple decision trees to improve prediction accuracy and robustness. Although it yielded slightly less accurate predictions than SVM and ANN, it demonstrated how ensemble techniques can produce more reliable results.

The efficacy of the machine learning models in predicting health responses based on the provided dataset was assessed using a number of significant performance metrics, including precision, recall, F1 score, and overall accuracy. Figure 3 shows the performance score values. These metrics offer a comprehensive insight into the models' ability to correctly identify and classify health responses. Support Vector Machines (SVM), with an astounding accuracy rate of 97.6%, was the top performer. Because of its high precision (0.975), the SVM model can predict health response classifications with accuracy while minimising the number of false positives. Its recall score of 0.974 indicates that it can identify a sizable portion of true positive cases while reducing false negatives. As a result, the model's overall predictive capacity was validated by the remarkable value of 0.975 obtained by the harmonic mean of precision and recall, or the F1 score. The SVM's performance shows how well it can discriminate between typical and aberrant health patterns, which is essential for timely and accurate interventions.

Artificial Neural Network (ANN), the runner-up, achieved an accuracy rate of 96.44%. The ANN demonstrated that it could not only make accurate predictions but also identify a significant percentage of true positive cases, with recall and precision scores of 0.964 and 0.965, respectively. Recall and precision are evenly balanced in the performance, as indicated by the F1 score of 0.965. Furthermore, Decision Trees (DT) yielded a remarkable accuracy rate of 92.2%, making them an indispensable instrument for health forecasting. The DTs' 0.922 precision and recall scores show that they are capable of making well-informed decisions and accurately identifying genuine positive cases. Their F1 score of 0.922 further emphasises their dependability. Lastly, with an accuracy of 89.9%, the Random Forest (RF) model best illustrates the advantages of ensemble techniques. Although RF's accuracy is not as high as SVM's or ANN's, its precision, recall, and F1 score of 0.899 demonstrate how trustworthy its predictions. Performance score of the proposed research is shown in Figure 3.

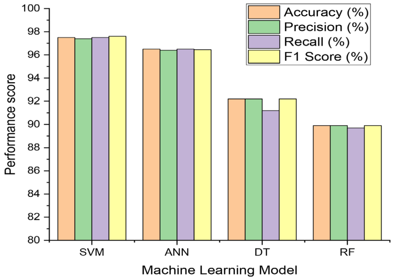

Figure 3. Performance score of the proposed research.

7 CONCLUSION

To conclude, this study has effectively illustrated the capability of a wearable sensor network system embedded in the IoT framework to practice advanced health monitoring and predict early health responses. We collected real-time sensor data by using machine learning, such as blood pressure and temperature, as well as blood oxygen levels and electrocardiograms: we got amazing results.Thus, by splitting 70% of the dataset for training and keeping the rest 30% for testing, we were able to test different machine learning models. Clearly, Support Vector Machines (SVM) is the best performing model due to 97.6% accuracy rate [3]. Proving SVM has better performance in the sense of confident prediction Moreover, clearly, all the metrics of precision, recall and F1 score show that how SVM can again perform much more accurate in term of reduce false positive (lower when tp is lower) and false negative (lower when tn is lower). This just further prove how good SVM are at making predictions on this problem! This revealed the efficiency of distinguishing abnormalities from regular health patterns thus allowing for interventions to be carried out in a timely manner. The Artificial Neural Network (ANN) also has proven its power by displaying an ability to identify complex patterns in the data with an accuracy of 96.44%. The performance of Decision Trees (DT) and Random Forests (RF) at the classification rates of 92.2% and 89.9%, respectively, was highly effective owing to their robust prediction ability, as well. The IoT ecosystem that we can use to better patient care and GoNGet his wellbeing. This paper provides the groundwork for future advances in wearable sensor networks, machine learning and predictive health modelling.

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Creative sustainability: Transforming household waste in India – A public survey on awareness and participation

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ABSTRACT: India grapples with long-standing waste management challenges exacerbated by factors such as population growth, densely populated urban areas, cultural diversity, and evolving lifestyles. The Municipal Solid Waste Management (MSWM) faces persistent issues in collection, treatment, and overall waste management by municipalities. In response to these challenges, this paper shifts its focus to households, aiming to address the core issue. Through comprehensive observation and analysis, the research delves into why the potential of household waste remains largely untapped [15]. The paper proposes practical solutions, underscoring the importance of recycling and donation initiatives. It advocates for a systematic segregation of waste types at the household level, offering a roadmap for individuals to actively contribute to sustainable waste management practices. By delving into the intricate dynamics of household waste, the research seeks to empower individuals to embrace environmentally friendly practices, fostering sustainable development at the grassroots level.

Keywords: Creative sustainability, Household waste, Recycle, Waste management

1 INTRODUCTION

Waste management is vital for sustainable waste disposal and reuse, encompassing collection, separation, transportation, and disposal to mitigate environmental harm. In India, like elsewhere, diverse waste types, from household to industrial, necessitate specific disposal methods due to varying environmental impacts. The Covid-19 pandemic heightened the urgency for sustainable waste management, revealing vulnerabilities in waste chains that could exacerbate disease spread and environmental pollution. This study examines India's waste management practices, focusing on E-waste, food waste, and household waste. It offers solutions, particularly at the household level, advocating for education and waste separation. By promoting recycling and reuse, the study aims to transform waste into a valuable resource, addressing India's waste challenges while fostering sustainability [11].

2 LITERATURE SURVEY

The research papers provide valuable insights into different aspects of waste management. For instance, Artiuch & Kornstein's study (2012) offers sustainable approaches to reducing food waste in India, potentially offering practical solutions. Vijayan *et al.* (2023) explore e-waste recycling behavior among households, contributing to understanding consumer attitudes. Colon & Fawcett's research (2006) offers lessons learned from a community-based waste management scheme in South Indian cities, potentially valuable for similar initiatives. Stoeva and Alriksson (2017) investigate the influence of recycling programs on waste separation behavior, shedding light on their effectiveness. However, certain studies have limitations. Tanabe's research focuses on contamination at e-waste recycling sites but may lack concrete

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solutions. Mohan *et al.* discuss e-waste management issues in India but may not offer definitive solutions for changing public perspectives. Jatindra & Sudhir present a case study of e-waste management in Bangalore, potentially limiting its applicability. Pandey *et al.* explore linkages between sustainable consumption and green practices but may overlook other important aspects of waste management. While these studies offer valuable insights, they are constrained by factors such as geographical specificity or insufficient solutions to identified issues.

3 METHODOLOGY/EXPERIMENTAL

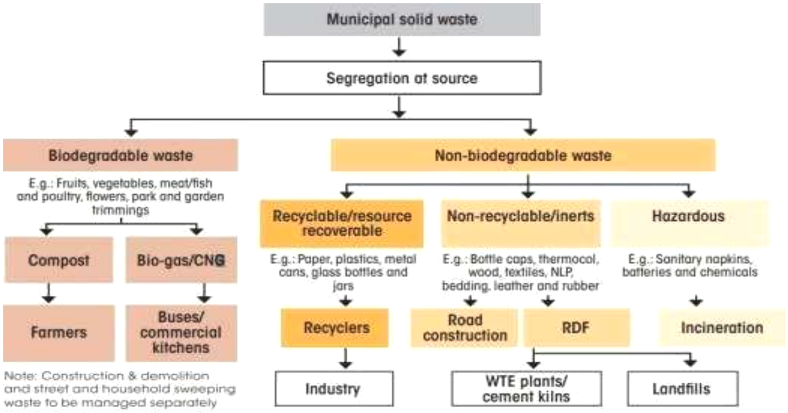
3.1 *Waste management in India*

Waste management involves processes aimed at waste disposal or sustainable reuse. It encompasses collection, segregation, transportation, and disposal. The primary goal is to minimize waste generation and ensure environmentally friendly disposal methods. Waste generated can be household or industrial and we need the right knowledge to dispose every type of waste produced.

Types of waste produced:

(1) E-waste
(2) Food waste
(3) Biomedical waste
(4) Radioactive waste
(5) Municipal solid waste how can this waste be managed?

Common waste management methods in India encompass composting, incineration, waste compaction, biogas generation, vermicomposting, and the 3Rs (reduce, reuse and recycle). Solid waste is segregated into biodegradable and non-biodegradable categories. Biodegradable waste, like fruits and vegetables, is composted or converted into biogas. Non-biodegradable waste, including recyclable materials like paper and plastic, is recycled, while non-recyclables like bottle caps are used in road construction. Hazardous waste, such as sanitary napkins, undergoes incineration. Our study focuses on optimizing disposal methods for the 5% and 7% categories of waste (Figure 1). While alternative disposal methods exist, they are not always accessible or environmentally friendly. Educating on safe and economical waste disposal is crucial, with potential for creative reuse to reduce environmental impact.


Municipal solid waste
Segregation at source
Biodegradable waste
E.g.: Fruits, vegetables, meat/fish and poultry, flowers, park and garden trimmings
Compost
Bio-gas/CNG
Farmers
Buses/ commercial kitchens
Note: Construction & demolition and street and household sweeping waste to be managed separately
Non-biodegradable waste
Recyclable/resource recoverable
E.g.: Paper, plastics, metal cans, glass bottles and jars
Recyclers
Industry
Non-recyclable/inerts
E.g.: Bottle caps, thermocol, wood, textiles, NLP, bedding, leather and rubber
Road construction
RDF
WTE plants/ cement kilns
Landfills
Hazardous
E.g.: Sanitary napkins, batteries and chemicals
Incineration

Source: Guidelines for Swachh Bharat Mission (urban) 2.0, 2021

Figure 1. Types of waste and disposal techniques.

3.2 *E-waste*

E-waste comprises discarded electronics like laptops, smartphones, and TVs, posing environmental and health risks due to toxic substances like lead and mercury [12]. Its improper management leads to pollution, health hazards, and social injustices. With the rising use of electronic devices, addressing e-waste demands a multifaceted approach. Waste generated is given in Table 1.

Table 1. Waste generated.

Financial Year	Generation (Tones)
2017–18	7,08,445.00
2018–19	7,71,215.00
2019–20	10,14,961.21
2020–21	13,46,496.31
2021–22	16,01,155.36

3.3 *E-waste in India*

India has emerged as the leading producer of electronic waste (e-waste) globally, surpassing China and the United States. According to data from the Central Pollution Control Board, India generated 1.71 million metric tons of e-waste, significantly contributing to the global e-waste generation of 59.40 million metric tons. The informal sector handles over 95% of this e-waste, exacerbating the issue. Rapid electronic product upgrades prompt consumers to dispose of old devices hastily, further contributing to the e-waste stream. Metropolitan cities in India are particularly affected, with 65 cities generating over 60% of the total e-waste, and 10 states contributing 70% of the total e-waste. The environmental toxicity resulting from e-waste is well-documented, posing risks to both human and animal health. Global e-waste management presents a complex landscape, emphasizing the importance of urban mining for achieving sustainability goals and transitioning to a circular economy paradigm [9].

3.4 *Household waste*

Household waste encompasses both hazardous and non-hazardous materials, including food scraps, packaging, and plastics, driven by urbanization and lifestyle changes. In India, 21% of waste is recyclable but often ends up in landfills due to inadequate infrastructure. However, recycling initiatives could lead to a $15 billion industry. Educating about recycling non-recyclable waste, as depicted in the pie chart (Figure 2), where food waste is dominant and non-recyclables like glass and plastic are minimal, could divert up to 21% of waste from landfills, promoting sustainability [8].

3.5 *Food waste*

Food waste, a global issue, arises from various factors such as inefficient practices and inadequate infrastructure. In India, challenges encompass agriculture to consumption, requiring holistic strategies for sustainability. Globally, approximately one-third of food is wasted annually, reflecting significant losses. In January 2022, India faced notable food waste challenges, with an estimated 40% wastage. Repurposing food waste as animal feed offers a solution, promoting circular bioeconomy principles [1,10].

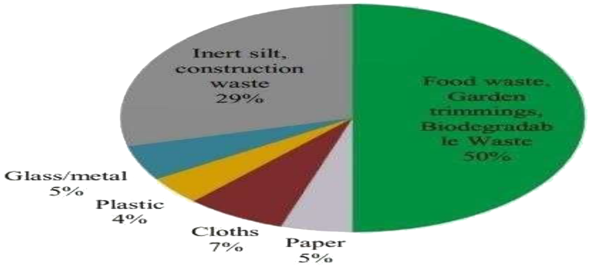


Figure 2. Pie chart of kinds of waste generated.

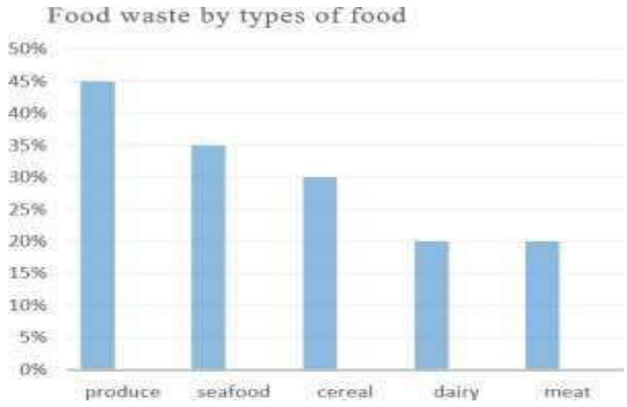


Figure 3. Food waste by type of Food 2.

Donation plays a crucial role in recycling, extending the life of unwanted items while fulfilling the basic needs of the less fortunate. By donating household items like furniture, clothes, toys, and books, waste gains a new purpose, reducing landfill burden. Urbanization fosters overconsumption, leading to excess waste, especially in affluent households. Plastic toys, for instance, contribute to microplastic pollution if discarded improperly. Donating such items to orphanages and NGOs not only mitigates environmental harm but also benefits those in need. Clothing donations alone can divert 7% of waste from landfills (Figures 2 and 3). Addressing extravagant lifestyles through donation offers a sustainable solution, promoting social responsibility and environmental stewardship.

4 CREATIVE SOLUTIONS

As seen earlier in Figure 3a we observe that if we eliminate all the minimum percentage waste then altogether a much bigger percentage of waste gets eliminated. Glass, plastic, metal, clothes, and paper are all materials that we can use more than once. We just need to know the safe and sustainable way to do so. Creative solutions focus on exactly this. Waste can be art [13]. Repurposing broken mirrors into mosaic designs or converting old clothes into blankets fosters family bonding while reducing waste. A single-family making blankets from old t-shirts could repurpose 10–15 shirts, potentially saving billions nationally. With 93,000 t-shirts sold daily, these initiatives offer significant waste reduction and promote sustainability.

5 SURVEY

Our survey focused on e-waste and household waste perceptions, revealing key insights. Addressing awareness gaps emerged as crucial for enhancing e-waste recycling, with 64% of respondents aware of recycling efforts, highlighting social media's role. Optimizing labor costs, improving facilities, and navigating regulations were identified as essential for e-waste recycling. Printed circuit boards (PCBs) emerged as a notable concern in the e-waste recycling process due to challenges associated with acid leaching for metal separation. This highlighted the need to explore alternative methods or improve the environmental sustainability of current practices to address this issue effectively.

The survey highlighted factors influencing waste recycling decisions, with environmental concerns prioritized by the majority (58.3%) of respondents, indicating a strong commitment to sustainability. However, a significant proportion (38.9%) felt hindered by a lack of awareness, underscoring the need for eco-friendly education. Convenience (25%) and incentives (11.1%) played lesser roles, suggesting environmental consciousness outweighs personal gain. Recycling emerged as the preferred disposal method for household waste (43.2%), while burning waste nearby (21.6%) was prevalent but less sustainable. Surprisingly, reliance on online resources for waste disposal solutions was low (2.7%). The survey also revealed diverse cleanliness practices, with some respondents attributing cleanliness to divine intervention (13.5%). Regarding food waste minimization, respondents favored comprehensive measures (67.6%), indicating a holistic approach, yet areas like meal planning (27%) and composting (8.1%) showed room for improvement [4]. The survey also assessed awareness levels regarding the environmental impact of improper waste disposal. While a majority (56.8%) demonstrated high awareness, a notable portion (29.7%) exhibited moderate awareness, suggesting opportunities for increased understanding. Moreover, 13.5% admitted to limited awareness, emphasizing the need for education on proper waste disposal practices.

Our survey provided valuable insights into people's perceptions and behaviors regarding waste management and generation, highlighting areas for improvement and the importance of continued education and awareness-raising efforts in promoting sustainable waste practices [3].

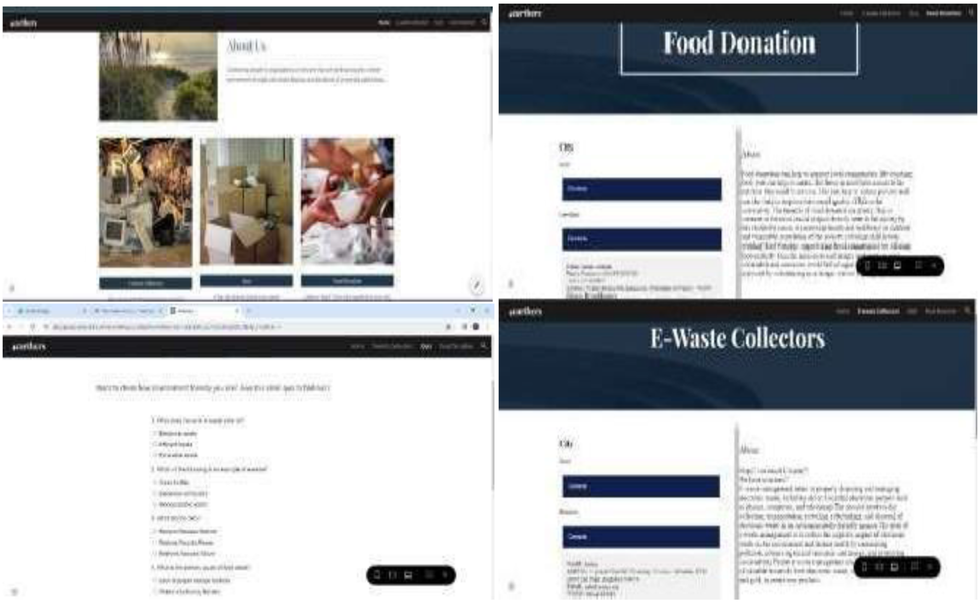


Figure 4. Developed website.

Figure 4 shows the website developed by us to increase connectivity of the public eye to people who actively work in recycling and to provide easy access to household waste management using creative sustainability practices.

6 CONCLUSION

In summary, this study highlights the urgency of sustainable waste management in India amidst rising waste generation. Analyzing various waste types, including e-waste and household waste, it stresses the importance of public awareness and engagement for effective waste reduction and recycling. Practical implications include the necessity for robust education campaigns, infrastructure improvements, and policy incentives to promote responsible waste practices. By addressing these challenges, India can transition towards a circular economy, mitigating environmental harm and ensuring long-term sustainability.

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Design and development challenges of TCLA adder for low power applications: A review

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ABSTRACT: The modern era, Carbon Nano-tube Field effect transistor (CNT FET) play a significant role in circuit design for various aspects. As the demand for high-speed and energy-efficient arithmetic units develops, it becomes critical to investigate novel adder architectures. Ternary arithmetic, with its potential for increased computational density and shorter carry propagation delays, has emerged as a possible alternative to binary arithmetic. The overview of the ternary logic has discussed initial phase, the next important parameters like propagation delay, power dissipation, power delay product. Energy delay product analysis has elaborated. Further literature survey has done from fast decade on ternary logic circuits, which can work efficiently with low power consumption. Then it digs into the architectural complexities of TCLAs, focusing on the methods for ternary carry look-ahead and efficient ternary sum generation. Various optimization strategies for increasing the speed and area efficiency of TCLAs are also examined, such as hybrid carry generation schemes and transistor-level optimizations.

Keywords: Ternary logic, TCLA-CNTFET, Novel ternary logic. Efficient, High speed

1 INTRODUCTION

To improve the performance of transistor-based logic circuit, a novel ternary logic circuits was implemented for low power consumption, less delay, less power delay product and energy delay product. The normal two input logic having the four input conditions and the ternary logic will be having the 8 input logics for two inputs. A logic circuit having the multiple number of inputs which gives the efferent output and less delay. Initially ternary logic was started which MOSFETs later this work was progressed for CNTFET ternary logic circuits. This work mainly concentrated on various MOS and CNTFET based ternary logics circuits which provided the low power and highly efficient by comparing with ordinary logic.

2 LITERATURE SURVEY

The introduction then continues with a discussion of CNT transistors, or CNTFETs, an important technology that facilitates ternary computation. CNTFETs are highly suitable for implementation in ternary logic gates that are characterized by low off-state leakage, high carrier mobility, and superb scalability. These attributes further enhance the transistors' efficiency and compactness while minimizing energy usage. Subsequently, high-speed arithmetic units incorporate carry look-ahead adders, which are commonly referred to as CLAs.

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The efficacy of conventional binary CLAs in high-frequency applications is impeded by carry propagation delays. [1,2,5].

3 DESIGN CONSTRAINS OF TCLA

Ternary Carry Look-Ahead Adders (TCLAs) are sophisticated arithmetic elements that produce carry signals in multiple phases to expedite the addition of ternary values. Ternary carry look-ahead adders (TCLAs) offer several benefits over traditional binary adders; however, their effectiveness is dependent on the resolution of specific design limitations.

3.1 *Ternary logic constraints*

TCLAs employ a ternary logic architecture, with each digit having three possible values: 0; 1, and 2. To guarantee dependable performance and precise calculation, ternary logic circuits must be meticulously constructed with signal levels, voltage thresholds, and noise margins in mind. The ternary digits LsV, HsV/2 and HsV in Table 1 indicate the coefficients of the powers of three in a ternary number. Ternary input representation for logic gates is shown in Table 1.

Table 1. Ternary input representation for logic gates.

Inputs		Outputs			
X	Y	TAND	TOR	TNAND	TNOR
LsV	LsV	LsV	LsV	HsV	HsV
LsV	HsV/2	LsV	HsV/2	HsV	HsV/2
LsV	HsV	LsV	HsV	HsV	LsV
HsV/2	LsV	LsV	HsV/2	HsV	HsV/2
HsV/2	HsV/2	HsV/2	HsV/2	HsV/2	HsV/2
HsV/2	HsV	HsV	HsV	HsV/2	LsV
HsV	LsV	LsV	HsV	HsV	LsV
HsV	HsV/2	HsV	HsV	HSV/2	LsV
HsV	HsV	HsV	HsV	LsV	LsV

3.2 *Carry propagation delays*

The significant challenge in adder design as they might restrict the speed of the adder. TCLAs use carry look-ahead techniques to reduce propagation delays, however the intricacy of ternary logic might cause extra delays as compared to binary adders. Let's represent the critical path delay of the TCLA as Dcrt. This delay consists of multiple elements, Dg reflects the total gate delays along the crucial path. The delays caused by ternary logic gates, carry generation logic, and other combinational logic in the adder are considered. Interconnect Delays Dint refers to the delay caused by routing carry signals between several stages of the TCLA. Effective power management is essential in TCLA design to reduce energy usage and prolong battery life in portable devices. Ternary logic circuits may require more power consumption compared to binary circuits because of the greater quantity of signal levels and transistor switching operations. Estimating the power dissipation of a ternary carry look-ahead adder (TCLA) can be intricate without detailed information about the implementation, technology, and other relevant factors. Nevertheless, a comprehensive method and variables that impact power dissipation in digital circuits such as a TCLA.

4 EXISTING TERNARY CARRY LOOK AHEAD ADDERS

4.1 *High-efficient ternary adder*

In this particular research endeavour, new ternary adders basic building blocks of ternary addition are introduced. They use a logic technique to do their operations, which primarily produces binary signals. This results in the lowest feasible level of static power dissipation. Many assessments are conducted in order to determine how effective the new designs are. Compared to the adder cells that were previously utilized, the ternary ripple adder built with the new ternary half and full adders has a 2.33 microwatt lower power consumption. Furthermore, it operates at about twice the speed. CNT field-effect transistors are employed to create innovative circuits due to their exceptional capabilities for ternary circuitry. This is a result of the transistors' suitability for real-world uses.

This work will lead to the presentation of new ternary adders based on a logic style that is primarily made up of binary components. As a result, static power consumption is reduced to the absolute minimum that is deemed feasible. Numerous types of comprehensive assessments have been conducted to investigate effectiveness in every conceivable way. The designs that have been demonstrated offer the following benefits: low power consumption, high driving power, full-swing operation, and compatibility with both high and low voltages and frequencies. All of these benefits have been offered. They can be used in more complex circuits in addition to being appropriate in real-world scenarios. A comparison between MOSFET and CNTFET has also been included in that part in order to reach the conclusion that MOSFET is the most efficient technology for ternary circuits. CNTFETs are without a doubt the most promising device in terms of ternary circuit deployment in the future.

4.2 *Novel CNTET based ternary adder*

In this research, a enhanced design for ternary logic gates is described. This design makes use of carbon nanotube field-effect transistors (CNTFETs), which are currently in use. In contrast to the conventional binary logic design method, tertiary logic is a legitimate option. As a result of the reduced circuit overhead, which includes interconnects and chip size. This is possible to accomplish simplicity and energy efficiency in modern digital architecture. This is due to the fact that they are both attainable. The construction of ternary logic that is based on CNTFET has been presented, and in order for it to be implemented, a design that is based on resistive-load CNTFET has been proposed. In order to provide a novel approach to the design of ternary logic gates that is founded on CNTFETs, the objective of this research is to evaluate and contrast it with the designs that are currently in use for resistive-load CNTFET logic gates [2].

4.3 *Optimized CNTFET based ternary adder*

The ternary designs that were recommended were implemented and simulated with the help of HSPICE. The results that were produced from the simulation show that the proposed designs are capable of fulfilling their intended functions in the manner that was planned.

4.4 *A novel CNTFET TCLA*

There are a number of benefits that the binary system offers in comparison to the tertiary value logic (TVL) system. These benefits include the capacity to give a smaller chip area and faster computation speed of the binary system. The implementation of ternary hardware, on the other hand, is currently going through the stages of theoretical and simulation development. Additionally, it is important to highlight that there is currently no hardware description language being created for ternary logic applications. Through the course of this work, both the implementation and analysis of ternary logic in FPGA are provided. In order to accomplish this, a trinary digit, which is a representation of one trit, is represented by two bits. In order to provide a description of the performance of the TVL, the field-programmable gate array (FPGA) is used to create the ternary carry lookahead adder. In addition to this, the arithmetic unit's speed as well as its power dissipation are measured. On top of that, simulations are carried out on the performance of the ripple carry adder, making use of both ternary and binary methods to logic [4]. To perform addition operations in ternary arithmetic applications, a specific digital circuit known as the Ternary Carry Look-Ahead Adder (TCLA) is used. Tertiary arithmetic is used for digits that can have any of the three potential values: 0, 1, or 2. TCLA is an expansion of the concept of conventional carry look-ahead adders, enabling applications spanning from binary to ternary arithmetic. This allows for the effective and efficient addition of ternary numbers. To accomplish this purpose, it generates carry signals for each of the ternary digits. As a result, the adder can perform carry computations concurrently across multiple stages [5–12]. In a typical setup, TCLA's architecture consists of a number of stages, each of which is in charge of processing one ternary digit of the input operands and generating the corresponding sum and carry-out signals. It is the task of the carry look-ahead circuitry in each step to efficiently compute the carry signals based on the ternary digits input. As a result, additions can be performed quickly while also reducing the time it takes for signals to travel through the network [13–16]. Comparison of various Ternary arithmetic adders is shown in Table 2.

Table 2. Comparison of various ternary arithmetic adders.

Design	CNFET'S counts	AVERAGE POWER (uW)	PDP (e-18 J)	EDP (e-27 J.s)
[2]	412	1.36	120	10.5
[3]	337	1.96	153	11.9
[4]	98	0.16	31	5.9
[5]	106	0.13	35	9.4
[6]	105	1.13	77	5.2
[7]	74	0.82	120	17.5
[8]	89	0.44	21	1
[9]	72	0.28	14.3	0.7
[10]	142	4.62	434	40.5
[11]	49	1.23	263	45.3
[12]	37	0.81	212	55.5
[13]	74	0.13	12.75	1.2
[14]	54	0.43	20	0.9
[15]	59	0.46	12.42	0.3
[16]	55	0.22	7.48	0.25

5 CONCLUSION

The review of Ternary carry-look ahead adders (TCLA) was completed by summarizing the main discoveries and their implications for ternary arithmetic and digital circuit design. First, the fundamental operation of ternary logic was demonstrated with examples, and various design characteristics of a ternary carry look ahead adder were mathematically analyzed. The operation of various TCLA has on related to power delay product, energy delay product analyzed according with MOS and CNTFET based circuits. Finaly, various distingued between various TCLA tabulated related to various parameters.

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Detecting anomalies in IoT sensor data using machine learning algorithms

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ABSTRACT: In today's interconnected world, the integration of Internet of Things (IoT) devices into networks has become increasingly prevalent. This extensive connectivity has raised concerns about threats and the evolving landscape of attacks. Recent studies have proposed machine learning (ML) and deep learning (DL) techniques to detect and classify such anomalies within the IoT framework. The primary objective of this project is to determine the most effective algorithm for detecting various types of attacks on such devices. The initiative aims to fortify IoT sensor networks by adopting a proactive stance to identify and mitigate potential threats, thereby safeguarding the integrity of these interconnected systems. According to our findings, deep learning algorithms like ANN exhibit greater accuracy compared to machine learning methods such as logistic regression and SVM, making them well-suited for future IoT measures.

Keywords: Deep Learning, IoT, Machine Learning, Algorithms, ANN

1 INTRODUCTION

The rise in the use of Internet of Things (IoT) devices has caused a significant increase in IoT-related attacks. One of the most concerning threats is the botnet attack, which poses a serious risk by aiming to carry out tangible, effective, and financially motivated cybercrimes. These attacks involve compromising IoT devices and turning them into a group of infected devices that are controlled remotely by an external attacker. It's quite a challenge to identify ongoing IoT botnet attacks and their corresponding networks due to the constantly changing nature of IoT systems. Developing effective methods to detect security vulnerabilities and counter various attack tactics is particularly tough because of this dynamic nature. In response to the growing threat landscape, there's a focus on advancing machine learning and deep learning-based tools for detecting malware, especially by utilizing full-time series data. Continuously collecting such data is crucial for these models. While current approaches involve ongoing data gathering during malware execution, instances where attacks successfully achieve their goal, causing information system sabotage, highlight the malicious nature of such malware. Despite available detection techniques for post-assault stages, identifying an ongoing IoT botnet attack and its corresponding network is still a significant challenge.

2 LITERATURE REVIEW

Lately, there's been a lot of focus on IoT security because of the increasing number of connected devices and the growing threat to upcoming networks [1]. Researchers have been looking into different approaches, like anomaly detection and intrusion prevention [2], to make sure that IoT ecosystems are safe [3]. In this study, we'll be evaluating these algorithms

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to see how strong and effective they are at ensuring stability across different types of data and problem areas.

We're talking about using logistic regression, which is a model for binary classification that estimates the likelihood of an event happening as explained in [4]. This, along with logistic regression and support vector machines [5], are being suggested for anomaly detection in IoT networks [6]. On top of that, federated learning has come up as a promising strategy for keeping data private [7] while training ML models across distributed IoT environments [8]. There are also proposals for a two-tier classification model [9], Grey Wolf Optimizer [10], and hybrid decision tree algorithms for spotting faults and intrusions in IoT systems. Plus, research has shown that random forest [12] and artificial neural network algorithms are effective for device authentication and cybersecurity in IoT applications [13]. By using techniques like random forest [14] regressor, predictive maintenance systems have the potential to enhance the reliability of industrial IoT setups. Random Forest, for example, is a technique that improves prediction accuracy and reduces overfitting. And artificial neural network (ANN), which is a pattern recognition technique involving interconnected nodes inspired by the human brain, is being used in [15]. These studies really show the wide range of methods and technologies being used to tackle the complex challenges of IoT security. It highlights how interdisciplinary this field is and emphasizes the need for cooperative efforts to develop strong, adaptable security frameworks.

3 PROPOSED SYSTEM

The architecture diagram (see Figure 1) that shows the plan for a system meant to handle data from IoT sensor devices. It processes the data securely through a sensing layer and uses a secure layer, which can even tap into cloud resources for data analysis and machine learning tasks. The goal of the system is to make sure the data stays intact, private, and accurate in its predictions. It also includes ways to detect and respond to attacks. By using one hot encoding and preprocessing the data, as well as trying out different machine learning models, we can figure out which model gives the best accuracy, is the most efficient, and performs with higher accuracy.

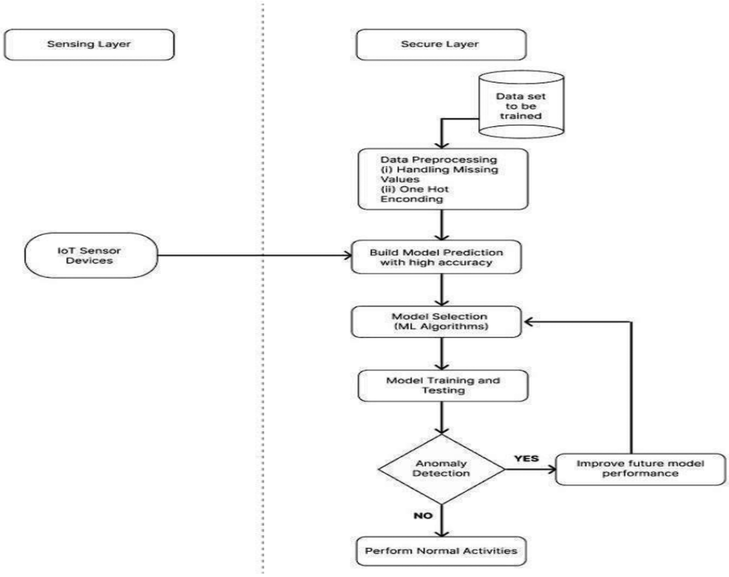
Sensing Layer
Secure Layer
Data set to be trained
Data Preprocessing (i) Handling Missing Values (ii) One Hot Enconding
IoT Sensor Devices
Build Model Prediction with high accuracy
Model Selection (ML Algorithms)
Model Training and Testing
Anomaly Detection
YES
Improve future model performance
NO
Perform Normal Activities

Figure 1. Proposed architecture diagram.

3.1 *Algorithms*

3.3.1 *Logistic regression (LR)*

It is a binary classification algorithm designed to predict the probability of an event. It utilizes the function to alter a linear combination of input features into a possibility score that falls within range of 0 to 1. Its popularity in binary classification tasks are attributed to its straight forwardness and ease of interpretation.

3.3.2 *Support vector machine (SVM)*

This algorithm is versatile and can be used both classification & regression tasks. It functions by finding the best hyperplane which can efficiently separate points of different classes within feature space. Its objective is to maximize the margin between classes, and it proves effective in handling non-linear relationships by employing kernel functions.

3.3.3 *Decision trees*

Decision Trees are non-linear and non-parametric algorithms employed in supervised learning for classification and regression purposes. This algorithm iteratively divides the dataset according to feature values, forming a tree-like structure. Internal nodes symbolize decisions based on features, while leaf nodes indicate the predicted value of the target variable. Decision Trees are interpretable and adept at handling both numerical and categorical data.

3.3.4 *Random forest*

It is a group learning technique that constructs numerous decision trees. Each tree is created by utilizing a random subset of both the training data and the features. The ultimate prediction is typically determined by the mode in classification tasks or the mean in regression tasks, aggregating predictions from individual trees. Renowned for its elevated accuracy, resilience, and capacity to address overfitting, this method is widely acknowledged.

3.3.5 *Artificial neural network*

It's a collection of algorithms similar to the human brain, aimed at pattern recognition. ANNs are comprised of interconnected nodes, or neurons, organized into layers. Each layer plays a role in the learning process: the input layer receives features, the output layer generates predictions, and hidden layers in between enable the network to grasp intricate patterns and representations. ANNs are powerful for tasks involving non-linear relationships and are commonly used deep learning and cyber security applications.

3.2 *Implementation of proposed system*

The IoT security system starts by gathering data from various sensors like temperature, motion, and humidity sensors placed throughout the IoT site. This data is then used as input for machine learning models. After that, the data is split into training and testing sets, usually with an 80-20 split, and 5-Fold Cross Validation is applied across all machine learning algorithms. Next, feature scaling is done to normalize or standardize the features, ensuring consistency and helping the model to converge. Categorical and numerical data are processed differently, with label encoding chosen over one-hot encoding to reduce dimensionality and avoid sparse features, which can be tough for machine learning algorithms to handle. Then, the model is trained, transforming nominal categorical data into vectors. Model assessment is carried out by applying the model to the validation dataset and evaluating its performance using metrics like support, precision, and F1 score. Based on the validation results, the model's parameters or structure may be adjusted for better effectiveness. Once satisfactory results are achieved, the model is tested on the test dataset to complete the evaluation. Finally, the validated model is implemented in a production environment, whether it's on a server or within a cloud-based platform, to effectively enhance IoT security.

3.2.1 *Dataset*

In this study used an open-source dataset from Kaggle and the Distributed Smart Space Orchestration System (DS2OS) to create synthetic data, mimicking a virtual IoT environment. The dataset provides a comprehensive overview of the distribution of various attacks and anomalies across all its components. It includes descriptions of 7 anomalies taken as features, all of which are of object type. Here are the features: 1. Denial of Service: This occurs when an excessive volume of unwanted traffic overwhelms a single source or receiver. 2. Data Type Probing: A malicious node intentionally uses a data category different from the intended one. 3. Malicious Control: Software vulnerabilities allow attackers to potentially obtain a legitimate session key or intercept network traffic. 4. Malicious Operation: These are typically initiated through malware, serving as a decoy activity to divert attention from the original operation. 5. Scan (SC): Data can be compromised during hardware scanning of the system, potentially leading to corruption. 6. Spying (SP): Attackers exploit system vulnerabilities, using a backdoor channel to infiltrate and uncover critical information. 7. Wrong Setup: Data may face disruption due to incorrect system configurations or setups. 8. Normal: Accurate data falls under the category of normal data. This combination of system and user prompts aims to enhance the assistant's ability to craft a more human-like version of the text while strictly maintaining the original content's intent and factual accuracy.

4 RESULT AND DISCUSSION

To validate the prediction models, we conducted various experiments with different machine learning models and deep learning models such ANN to reach an improved accuracy. Comparison of Accuracy of Algorithms is shown in Table 1.

Table 1. Comparison of accuracy of algorithms.

Name of Algorithm	Accuracy in percentage (%)
LR	98.3
SVM	98.2
DT	99.3
RF	99.4
ANN	99.4

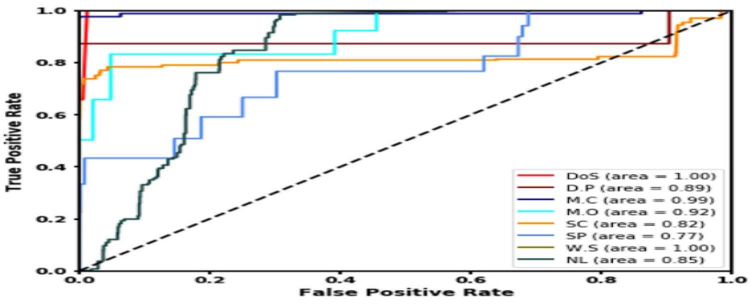

Figure 2. ROC curve for algorithms such as Logistic Regression and SVM.

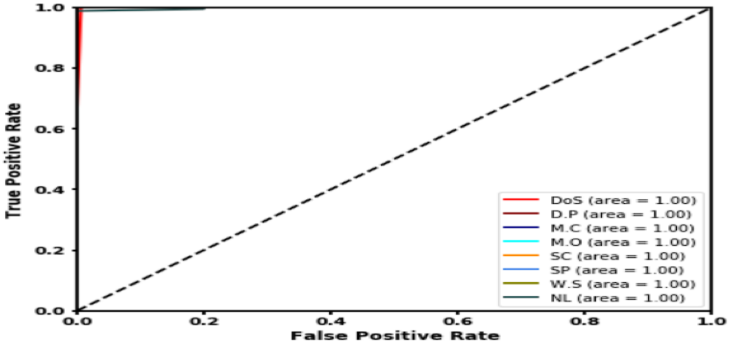

Figure 3. ROC curve for RF and ANN.

Based on the results of cross-validation, (Figures 2 and 3) it is evident that Random Forest (RF) and Artificial Neural Network (ANN) exhibited superior performance in both training and testing accuracy. Decision Trees (DT) showed comparable performance to RF and ANN during training but demonstrated more significant deviations in testing, indicating initial poor performance. Notably, Decision Trees (DT) and Random Forest (RF) outperformed other techniques, displaying showcasing better F1 score. It demonstrated strong performance in the evaluation phase, although RF & DT exhibited slightly greater accuracy. Conversely, logistic regression as well as SVM performed well on the dataset but did not achieve the same level of effectiveness as the aforementioned classifiers. The curves for all the algorithms indicate that random forest, decision tree and artificial neural network exhibit higher accuracy, as evidenced by part below curves being consistently close to one for every class. Using the ROC curves a clear result can be clearly depicted that ANN and RF have the least amount of false positive rates and are perform better than the rest of the machine learning algorithms used. Since ANN can perform better with large datasets and can map input data it comes out to be better than RF model producing lower false rates and performing better.

5 CONCLUSION

After rigorously testing and comparing various machine learning algorithms for spotting anomalies in IoT sensor data, it’s clear that artificial neural networks (ANNs) are the top choice. Our assessments have shown that ANNs are more accurate and reliable at pinpointing anomalies in the complex and ever-changing datasets produced by IoT sensors. ANNs have a natural knack for capturing intricate patterns and dependencies in data, making them especially well-suited for anomaly detection tasks. Plus, their versatility allows them to handle different types of sensor data and adapt to various environmental conditions, ensuring strong performance in diverse IoT setups.

6 FUTURE SCOPE

Moving forward, continued research and innovation in the field of machine learning based security for IoT sensor networks will be essential for staying ahead of emerging threats and safeguarding critical infrastructure. By integrating real time data collection and advanced analytics, we can enhance the resilience of IoT systems against malicious activities, ultimately contributing to a safer and more secure digital ecosystem with deep learning algorithms such as ANN being more prone to success with real time data more evidence-based investigation is required to address this issue, with a specific focus on real-time data. Within the IoT network, microservices exhibit varying behaviors at different instances, leading to deviations from the norm in IoT services and thereby generating anomalies. Further research is essential to gain a deeper understanding and interpretation of these issues.

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Detection and prevention of IP address spoofing in smart environment using Zigbee networks

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ABSTRACT: The Internet of Things (IoT) is vital for modern smarter environments but is in danger of common threats like IP address spoofing, in which a hacker alters an IP address so that it seems the activities in the network are coming from a trusted device. Using artificial intelligence, it is a way to stop it, enabling it to decide at different steps and at the centre of the network of low-cost Zigbee networks. Protection, such as strong authentication, encryption, and secure key management protocols, is vital. Detect anomalous behavior: Anomaly detection tools track the patterns of your network and identify if something is outside of normal activity. You can further increase security and resilience by combining advanced intrusion detection with Zigbee networks and restricting network access by access control.

Keywords: Internet of Things, Smart environments, IP address spoofing, Wireless communication, Zigbee networks, segmentation and access control

1 INTRODUCTION

IP address spoofing is a deceptive form of network technique where an attacker can able to manipulate the source IP address of packets. They are used to detect the true identity of the person in an online platform without their knowledge. The IP address indicates the sender's identity and location which is the important factor for routing and communication. This leads to various malicious activities. The most common application of IP address spoofing is defined as Distributed Denial of Service (DDoS) attacks. IP address spoofing can be used in various cyber-attacks [1,2]. The artificial intelligence plays a crucial role in the IP address spoofing.

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This helps to detect the attack and malicious behavior much more accurately [3,4]. AI algorithms always provide realistic data. This eliminates the traditional security measures. They can able to learn from various patterns and tend to obtain newer solutions [5–7]. Artificial intelligence provides an important way of defending against the various malicious attacks in the network [8,9]. Another important part includes the Internet of Things. This is an innovative dimension in the complex evolving structures. There are various devices in which the IoT becomes an indispensable part ranging from thermostats to industrial applications [10–12]. The IoT evolves the development of various applications through providing easier access to information even at remote places. These devices are compromised by cybercriminals to extract various information and highly sensitive content. There are various challenges in the detection of various malicious activities in the network [13–15]. IP Address Spoofing is shown in Figure 1.

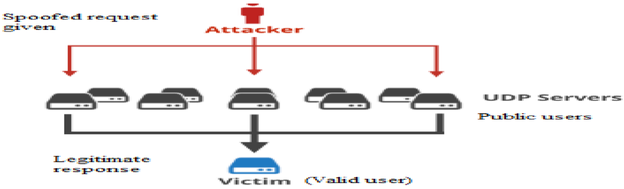


Figure 1. IP address spoofing.

They are hidden activities done through breaking the firewall of the website. They are largely used to extract highly sensitive information. They affect smart environments in several ways. IP address spoofing is used to intercept and transfer within the smart environments [16,17]. This results in the spread of false information. Attackers may always use the IP address spoofing to launch DDoS attacks by flooding into the network. Figure 1 demonstrates the IP address spoofing.

2 EXISTING SYSTEM

The existing system as shown in Figure 2 involves the detection and prevention of IP address spoofing using machine learning algorithms which results in various drawbacks.

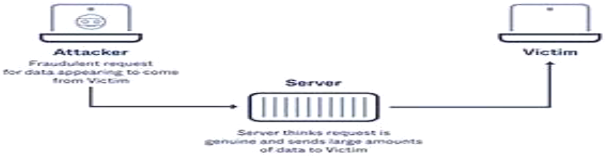

Attacker
Fraudulent request for data appearing to come from Victim
Server
Server thinks request is genuine and sends large amounts of data to Victim
Victim

Figure 2. Existing system.

- The machine learning based detection of IP address spoofing requires large amounts of substantial amounts of labelled data for processing. Machine learning is a form of dynamic nature in which new individuals may join and leave at any time which results in the reduction of stability of the system.
- The diversity of the communication protocols in the smart environments makes it a challenging task to build a robust machine-learning model.
- IP address spoofing detection systems using machine learning suffer from various constraints. This includes false positives and false negatives. False positives can lead to unnecessary security alerts. This results in potential disruptions in the smart environments. The false negative leads to compromising the security of the network.
- The machine learning based algorithms are susceptible to various evasion techniques. This leads to a lack of balance between sensitivity and specificity.

- The cat and mouse game creates various challenges in maintaining the security of smart networks. The resource requirement for ML based IP address spoofing detection can be significant. The training of these models may be computationally intensive.
- Privacy concern is also one of the important factors. The machine learning detection system can able to analyze the network traffic that potentially exposes sensitive information.
- Obtaining a proper balance between security and privacy is a challenging task.

To overcome these challenges, the proposed system is implemented using Zigbee networks.

3 PROPOSED SYSTEM

Detecting and preventing IP address spoofing in a smart environment that utilizes ZigBee networks enhances the security and privacy of the data. The challenges in IP address spoofing involve various measures as shown in Figure 3.

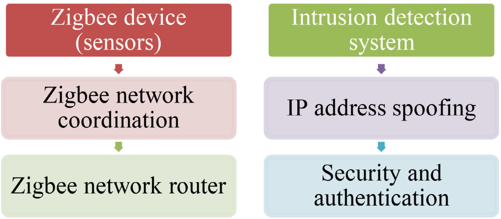

Zigbee device (sensors)
Zigbee network coordination
Zigbee network router
Intrusion detection system
IP address spoofing
Security and authentication

Figure 3. Stages in the prevention of IP address spoofing.

Device authentication – Device authentication is an important stage in which robust device authentication mechanisms need to ensure that only authenticated devices can able to join the Zigbee network. The devices must be required to obtain digital certificates during the initial connections. This helps prevent unauthorized devices from entering the network.

Secure key exchange – Through the aid of using secure key protocols such as Elliptical curve cryptography. This helps to obtain secure communication channels between the networks. This ensures the data transmitted within the network is encrypted in secure.

Packet filtering and inspection – Packet filtering and inspection is employed at the network gateway or edge filtering. These mechanisms can inspect incoming traffic for unusual patterns in the network.

Intrusion Detection System – The intrusion detection system is specifically designed for the Zigbee networks. These IDS can able to monitor the network traffic and behaviour.

Firmware and software updates – The frequent updation of the firmware and software of ZigBee devices to overcome the known vulnerabilities in the system. Manufacturers can release the patches and updates that hep to overcome the potential security flaws that are addressed by the attackers.

Network segmentation – Dividing the segments into numerous paths and tending to restrict the flow of traffic between them leads to overcoming IP address spoofing.

4 IMPLEMENTATION OF THE PROPOSED SYSTEM

Stage 1: Network topology discovery – The first stage involves the discovery of neighboring nodes in the network. They play an important role in the detection of IP address spoofing techniques. Table 1 shows the Shared key & Neighboring nodes.

Table 1. Shared key & neighboring nodes.

Node ID	Zigbee address	Shared Key (K2)	Neighbouring nodes
Node 1	0 × 001	0 × 2B4E5F8C1A3D	Node 2, Node 1
Node 2	0 × 002	0 × 5D3E7A6B1C8F	Node 2, Node 1
Node 3	0 × 003	0 × 9A6D2B3E1F8C	Node 2, Node 3
Node 3	0 × 004	0 × 8F3C5B7E2A1D	Node 2, Node 3
Node 4	0 × 002	0 × A8C7B5E4F2D1	Node 2, Node 3

Stage 2: Secure key exchange – The principal of secure key is used to make the kind of secure detection the key is able to simplifies robust defense and strong authenticity by the use of Encrypted communication such as Diffie-Hellman key exchange likewise. The commonly-known shared key, critical to both network authentication and prevention of spoofing with a multitude of internet protocols. It keeps the communication point safe and prevents any threat from being made.

Stage 3: Data packet transmission. Table 2 shows the Message alerts.

Table 2. Message alerts.

Node ID	Zigbee address	Message
Node 1	0 × 001	Temperature Reading
Node 2	0 × 002	Temperature Reading
Node 3	0 × 003	Temperature Reading
Node 3	0 × 004	Temperature Reading
Node 4	0 × 002	Temperature Reading

Stage 4: Data packet reception. Table 3 represents the digital signature

Table 3. Digital signature.

Node ID	Zigbee address	Digital signature
Node 1	0 × 001	Signature
Node 2	0 × 002	Signature
Node 3	0 × 003	Signature
Node 3	0 × 004	Signature
Node 4	0 × 002	Signature

Stage 5: IP-MAC Address Mapping. Table 4 shows the IP address.

Table 4. IP address.

Node ID	Zigbee address	IP address
Node 1	0 × 001	192.168.1.1
Node 2	0 × 002	192.168.1.2
Node 3	0 × 003	192.168.1.3
Node 3	0 × 004	192.168.1.4
Node 4	0 × 002	192.168.1.5

Stage 6: Packet inception – Packet inception, also known as packet or ingress filtering, is a BGP security practice that examines and validates incoming packets at the network's perimeter to ensure source IP legitimacy. Table 5 demonstrates the Sample packet data.

Table 5. Sample packet data.

Node ID	Zigbee address	Data destination
Node 1	0 × 001	192.168.1.2
Node 2	0 × 002	192.168.1.1
Node 3	0 × 003	192.168.1.2
Node 3	0 × 004	192.168.1.4
Node 4	0 × 002	192.168.1.4

Stage 7: IP spoofing detection. Table 6 represents the IP mac address detection.

Table 6. IP mac address.

Node ID	Zigbee address	IP Mac address
Node 1	0 × 001	192.168.1.1
Node 2	0 × 002	192.168.1.2
Node 3	0 × 003	192.168.1.3
Node 3	0 × 004	192.168.1.4
Node 4	0 × 002	192.168.1.5

Stage 8 & 9: Zigbee address & Threat detection. Table 7 shows the Zigbee address for each node, the Malicious attack detection and accuracy.

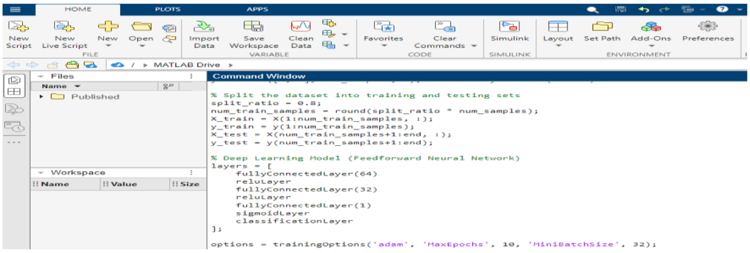
Table 7. Procotol, malicious attack detection & accuracy.

Node ID	Zigbee address	Malicious attack	Accuracy
Node 1	0 × 001	Yes	92
Node 2	0 × 002	No	96
Node 3	0 × 003	No	97
Node 3	0 × 004	No	98
Node 4	0 × 002	No	87

Stage 10: Performance analysis – The accuracy of zigbee network in the detection of IP address spoofing helps to detect the performance metrics of the system.

5 SIMULATION RESULT

The performance analysis of the proposed system is evaluated through running in Matlab Simulink as demonstrated in Figure 4.



```
% Split the dataset into training and testing sets
split_ratio = 0.8;
num_train_samples = round(split_ratio * num_samples);
X_train = X(1:num_train_samples, :);
y_train = y(1:num_train_samples);
X_test = X(num_train_samples+1:end, :);
y_test = y(num_train_samples+1:end);

% Deep Learning Model (Feedforward Neural Network)
layers = [
    fullyConnectedLayer(64)
    reluLayer
    fullyConnectedLayer(32)
    reluLayer
    fullyConnectedLayer(1)
    sigmoidLayer
    classificationLayer
];

options = trainingOptions('adam', 'MaxEpochs', 10, 'MiniBatchSize', 32);
```

Figure 4. MATLAB implementation.

```
Output:
Sending data from Node 3 to Node 5
Data: Hello, ZigBee Network!
Data sent successfully from 192.168.1.3 to 192.168.1.5
Node 1 IP Address: 192.168.1.1
Node 2 IP Address: 192.168.1.2
Node 3 IP Address: 192.168.1.3
Node 4 IP Address: 192.168.1.4
Node 5 IP Address: 192.168.1.5
```

Figure 5 demonstrates the performance metrics of the ZigBee network.

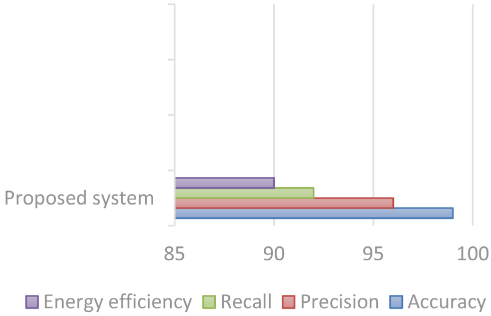


Figure 5. Performance metrics.

6 CONCLUSION

Detecting and preventing IP address spoofing in smart environments using Zigbee networks helps in improving and security and reliability of the network. They are largely used in various smart environments due to their properties of low power and wireless capabilities. They form an attractive target for attackers looking to exploit vulnerabilities and data traffic. This is a simplified and robust method for detecting and preventing IP address spoofing. ZigBee networks are susceptible to IP address spoofing due to their wireless and resource constrained properties. The implementation of strong authentication and authorization mechanisms is obtained through the Zigbee networks. IP address spoofing can be reduced through the developed system. The intrusion detection systems must be deployed in the zigbee networks for continuous monitoring of suspicious behavior.

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Detection of toxic gasses in laboratory using IoT based system

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ABSTRACT: The study of several hazardous and toxic gasses is discussed and summarized in this article. In most cases, the laboratories at educational institutions use these hazardous gasses. Under appropriate supervision, these must be observed in order to control any undesired issues. These days, IOT plays a very demanding function in monitoring and preventing undesired difficulties in laboratories. One of the most catastrophic mishaps that can happen in labs, workshops, warehouses, and industrial locations that use or store these chemicals is the release of hazardous gasses and chemical vapors. The prompt detection and alert of volatile chemicals and hazardous gasses is important to maintaining the safety conditions for the people and other living things that work in and around these locations. The major objective of this study is to propose a IOT based prototype to monitor and control different hazardous gas by exploring detection and warning systems, taking into account a number of technical factors, including the type of gas detection technology being used, the manufacturing technique of the sensors, the characteristics of the processor and the communication technology type.

Keywords: Toxic gasses, IoT system, Chemicals

1 INTRODUCTION

Day by day new medicines are discovered by scientists who can make human survival easy. To discover new medicines, they need different chemicals. Discovery of new drugs involves use of various toxic, nontoxic and hazardous chemicals which may produce fumes and toxic gasses during reaction or on storage of chemicals. The fumes and toxic gasses which are produced by the chemical are dangerous for the humans and environment. Fumes and toxic gasses gives different harmful effect in different parts of the body. [1] Laboratories are hotbeds of innovation, where groundbreaking discoveries are made daily. However, they also harbor the potential for unexpected hazards and toxic gases leak problems. To prevent this problem, we need an IOT (Internet of things) based system which can detect the problem and provides its solution and it starts all the alarm system. The IoT plays an important role in the detection of toxic gasses in laboratories by providing a connected and intelligent system for monitoring, alerting, and managing potential hazards. IoT-enabled gas detectors can be placed in various locations within the laboratory to continuously monitor the air quality in

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real-time. Data from these sensors can be transmitted to a centralized platform or cloud server, allowing for remote monitoring by laboratory personnel. When toxic gases reach unsafe levels, IoT devices can trigger instant alerts through notifications, emails, or other communication channels. Immediate notifications enable quick response and help prevent potential accidents or health hazards. [2] IoT devices collect and store data over time, allowing for the analysis of trends and patterns. Labs can find recurring problems, evaluate the efficacy of safety precautions, and make well-informed decisions to increase overall safety by looking at past data. IoT sensors can be integrated into the laboratory's Building Management Systems, allowing for centralized control and coordination of safety systems. [3] In the event of a gas leak, the Building Management Systems can automatically initiate safety protocols, such as activating ventilation systems or triggering alarms etc. IoT devices can contribute to energy efficiency by optimizing all controlling systems based on real-time gas concentration data. This not only enhances safety but also helps laboratories to operate more efficiently, potentially saving on energy costs. IoT solutions are scalable and can be easily expanded to accommodate changes in laboratory size or layout. Additional sensors can be deployed as needed to cover new areas or respond to evolving safety requirements. [4] IoT devices can be integrated with emergency response systems to ensure a coordinated and rapid reaction in the event of a gas leak. This integration can include automatic alerts to emergency services and first responders, facilitating a swift and organized response. Many IoT platforms offer user-friendly interfaces that enable laboratory personnel to easily monitor gas levels, view historical data, and configure alert settings. By leveraging the capabilities of IoT in gas detection, laboratories can enhance safety measures, reduce response times to potential threats, and create a more secure working environment for researchers and staff. [5]

2 LITERATURE REVIEW

Toxic gases can be present in pharmaceutical chemistry labs due to various chemical reactions and processes. [6] When handling these materials, it is essential to be aware of the possible risks and take the necessary precautions.

Acetic acid vapors, with a boiling point of 118°C and a pungent odor, exist in a colorless physical state and exhibit milder chemical reactivity compared to strong acids. They pose fire and explosion hazards, with a flammable flash point of 39°C and explosive limits ranging from 5.4% to 16%. Detection can be performed using an ATI acetic acid vapor sensor capable of measuring concentrations from 0 to 100 ppm. [7,18] Hydrogen sulfide, with a boiling point of −60.33°C, emits an offensive odor, presenting as a colorless gas. It demonstrates high chemical reactivity and poses fire and explosion hazards, with an ignition temperature of 260°C and explosive limits ranging from −4.3% to 46%. Detection is facilitated using a catalytic sensor. Chlorine gas, with a boiling point of −34.05°C, emits an irritating odor and appears as a greenish-yellow gas. It is highly reactive, capable of reacting with most organic and inorganic compounds, leading to fire and explosion hazards. Detection is typically achieved using electrochemical sensors. [6,7] Ammonia, with a boiling point of −33.35°C, emits a sharp and pungent odor and exists as a gas at room temperature. It is very reactive but stable, with a flash point of 11°C and an auto-ignition temperature of 651°C, making it not highly flammable. Detection typically employs electrochemical sensors. [16,17] Sulfur dioxide, with a boiling point of −10°C, emits a pungent smell and appears as a colorless gas. Detection typically involves sensors designed specifically for sulfurtion typically involves sensors designed specifically for sulfur dioxide (SO2). [14,15] Phosgene, with a boiling point of 8.2°C, surprisingly emits a pleasant odor despite its toxicity. At room temperature, it appears as a colorless gas and reacts with alcohols, copper, and ammonia. Although it has a flash point and is considered non-flammable, it poses significant health risks. Detection is typically performed using a phosgene gas detector designed specifically for COCl2. [12,13] Nitrogen dioxide, with a boiling point of 21.15°C, emits a strong, harsh odor and appears as a reddish-brown gas. It is not combustible, though it poses significant health risks. Detection is typically performed using an Alpha sense NO2 sensor. [10,11,19]

Carbon monoxide, with a boiling point of −191.5°C, is odorless and appears as a colorless gas. It is highly reactive and poses significant fire and explosion hazards, with a flash point of −191°C and an auto-ignition temperature of 609°C. Its explosive limits range from 12.5% to 74.2%. Detection typically involves the use of a CO detector. [19,20] Sulfur trioxide, with a boiling point of 44.8°C, emits a strong, pungent odor and exists as a colorless gas. It is extremely reactive but is nonflammable and non-explosive. Detection typically involves sensors designed for sulfur dioxide (SO2), which may also detect sulfur trioxide due to their similar chemical properties. Hydrogen chloride, with a boiling point of −85°C, emits a pungent odor and exists as a gas. It can react with many substances due to its high chemical reactivity. While it is not flammable, it can pose health risks. Detection is typically performed using an HCL-A1 sensor. [8] Iodine vapors, with a boiling point of 184.3°C, emit an irritating, strong, sharp odor and appear as a volatile colored gas. They are less reactive than other halogens and are non-combustible. Detection is typically performed using a photoionization sensor. [6,18]

3 METHODOLOGY

IOT (Internet of things) main aim is to make life simpler by automating every small task around us and the working speed of IOT system is way faster than human. According to some research the traditional gas leaking detector system, though having great precision, fails to acknowledge a few factors in alerting the people about the leakage. That's why we need an IOT based system to detect the gas leaking. IOT based system is an automating system which works on the basis of data. With the help of IOT based system we can enhance the existing safety standards. This system operates with low power consumption. Remote monitoring helps in monitoring gas levels and provides flexibility, making it easier to keep tabs on multiple locations simultaneously. Figure 1 shows the block diagram of a proposed model for the monitoring of laboratories containing hazardous gasses using an IoT based system. All the sensors are connected as the input and water spray, cooling fan and LCD is connected as output. The values received from different sensors are applied to the microcontroller. This processed information is further communicated to the end user by using communication protocols.

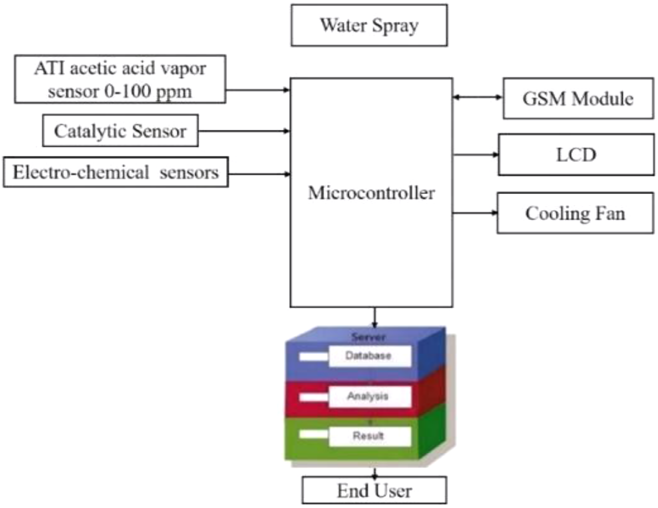

Figure 1. Block diagram of proposed model.

Figure 2 shows the flow diagram of the mechanism of controlling toxic gasses, fumes, temperature and smell. The controller helps to monitor all sensor inputs, and the laboratory's state is tracked using the controller's output data. This data can be used by the final user to keep track of the laboratory's progress. The threshold values of these several parameters—temperature, smell, and gas leakage—are compared using comparators. The water spray and cooling fan will operate, if necessary, based on the data supplied by the controller. At the same time an alert message will be delivered to the control unit and end user.

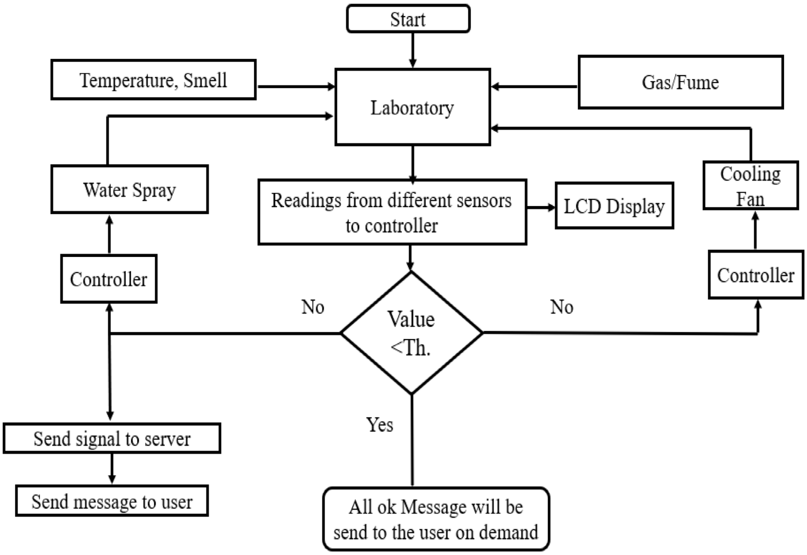

Figure 2. Different parameters detection flow chart.

4 CONCLUSION

Hazardous gas monitoring is essential to prevent accidents in labs, industry, and educational settings. Remote access to these regions is simple with the aid of IoT. An IoT-based monitoring system's initial setup costs, which include the cost of sensors and IoT hardware, can be high. Accurate data collection requires routine maintenance of sensors and IoT infrastructure. Time and money can be saved by using advanced technology to detect gasses, room temperature, and smells early. Future technological advancements, such as the use of artificial intelligence in predictive analytics, are expected as it continues to advance. By utilizing the newest technology, such as several sensors that forecast gasses and smells with a high degree of accuracy, this system can be made even more sophisticated. Cloud servers can be utilized to share information and monitor these systems via mobile apps. These systems must be required for lab setup in order to avoid any accidents in future.

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Development of cloud infrastructure with improved auto scaling and elasticity with real time data analytics

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ABSTRACT: Recent cloud infrastructure developed artificial intelligence techniques have made a big improvement in the terms of auto-scalability and elasticity. * With the use of Convolutional Neural Networks (CNN), Recurrent Neural Networks (RNN) and Long Short-Term Memory (LSTM) networks. It also ensures efficient utilization of resources. Auto-Scaling allows the number of compute resources to be adjusted based on demand. We can define Elasticity as the property of expanding and contracting infrastructure, based on specific needs at a very particular time. We are able to assess and control how computational resources will operate for performance gains. These are mostly utilized in environments where the workloads change regularly. It helps to take out big data like the shoutout pictures extracted above Dynamic datasets are well handled by the deep learning techniques. We perform spatial analysis with CNN (Convolutional Neural Network) on image and object recognition. RNN helps in Analysing Sequential Data with Improved Analysis of Time-Series Information and Natural Language Processing LSTM for long term dependency on data in the sequence. That allows us to obtain time series forecasting. Although it also provides real-time data analytic, the other added advantage by infusing deep learning in cloud infrastructures is possible to arrive at better results. This allows the infrastructure to be scaled up, or more likely, down (based on processing power needs).

Keywords: Cloud infrastructure, Deep learning, Auto-scaling, Elasticity, Real-time data analytics, Time-series forecasting

1 INTRODUCTION

Cloud computing is a technology that provides computer services over the Internet, allowing users to access resources on a pay-as-you-go basis. It reduces infrastructure investments and

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offers characteristics such as on-demand self-service, resource pooling, elasticity, and access to a wide network. Scalability is a key feature that allows users to allocate computing resources as needed through virtual technology. Cloud computing (Figure 1) is classified into three models: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS) [4,5]. Deployment models include public cloud, private cloud, and hybrid cloud. Public clouds are owned and operated by third parties, while private clouds offer more control over security and customization. Hybrid cloud combines private and public clouds, facilitating data sharing. The benefits of cloud computing include cost reduction, scalability, improved collaboration, and efficient resource utilization. Security and privacy concerns are addressed through smart technology, with the integration of artificial intelligence (AI) enhancing security measures [6]. AI optimizes resource utilization, predicts demand fluctuations, and automates tasks like configuration management. The combination of AI and cloud computing technologies enhances efficiency, adaptability, and performance optimization. This integrated system also supports the development and deployment of AI applications, harnessing the power of big data and providing automatic decision-making capabilities [7]. Ultimately, the integration of AI and cloud computing technologies improves operational parameters and scalability while offering a powerful defense against cyber threats and disruptions.

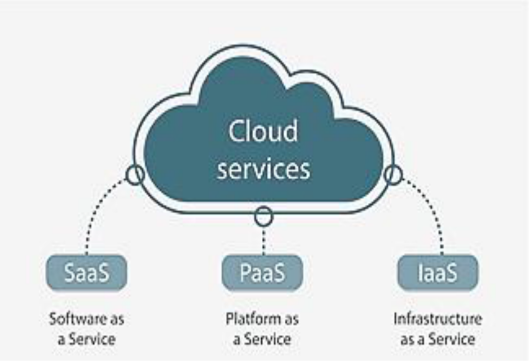

Figure 1. Cloud infrastructure.

2 PROPOSED METHODOLOGY

The aim of the proposed system is to give cloud infrastructure auto-scaling and elasticity with a better approach. The service elasticity is achieved on different cloud platforms and virtualized data centers It is called capability of the system to adapt with the varying dynamic workload environments. Whereas, the benefits of service elasticity adaption are twofold including Quality of Service (QoS) and minimized power consumption. Proposed system in difference stages is illustrated in Figure 2. QoS are defined in terms of several service metrics that includes response time, throughput and service responsiveness. Which are proven using Service Level Agreements (SLA). eliminates resource over-provisioning enabling lower power consumption. g. Over-provisioning is one common and easy solution that many service providers use which just inflate available resource to have peak amid maintained cpu_util [VIII-B]. Service elasticity used during the design of service helps in less amount of resources to fully establish the given service Auto-scaling implementations by cloud providers These HDFS benchmarks are based on some performance metrics and those are hardware and service metrics. E.g: Memory, CPU, response time and queue length. Auto scaling can be divided into the following two phases: Reactive mechanisms are defined to monitor the system and trigger specific scaling action whenever certain condition is met. The important constraints are insufficient reaction time for the overloading of the system. The proactive mechanisms predict the actual amount of resources.

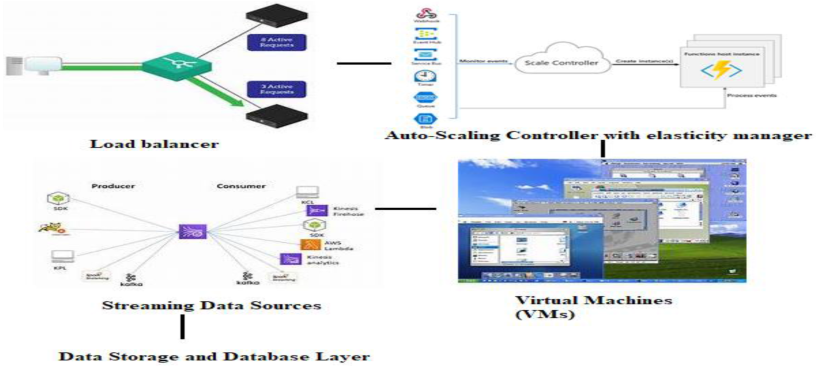

Figure 2. Stages in the proposed system.

Auto-provisioning auto replenishes the resources involved for ideal functioning of optimal provision cloud computing. The components of a self-scaling cloud architecture include, among others: load balancers, stretch parameters, policy monitoring and Cloud Provider APIs. The system uses deep learning-based time series prediction to accurately predict elastic cloud services load A load balancer will balance your network traffic across several servers and keep the use of resources in check. A stretch parameter carrying capacity of machines and containers. Policy monitoring: tracking system performance via metrics (e.g., CPU utilization) and triggers corrective action based on the threshold/metrics. These APIs interact with providers such as AWS Auto Scaling, Azure Virtual Machine Scale Sets and Google Cloud instance pools to increase or decrease available resources. Autoscaling functionality distributes the requests of a web application across VMs based on this-first come, first-served policy. Auto-Scaling §Starting and shutting down elastic VMs according to the load of the system. Because the main goal is that Autoscaling can adapt well to any changes arisen on workload fluctuations. That requires accurate load prediction.

3 INTEGRATION OF CLOUD INFRASTRUCTURE WITH DEEP LEARNING

Development Phases Description Phase 2 (Improvement) Developed cloud infrastructure on the second phase are observant in seeking full operations performance parameters Source: Author’s formulation. CSP stands for Cloud service provider; choosing a system, e.g., AWS, Azure and GCP provided with an AWS shell. The following will be the to-be-specified activities in cloud architecture design: To decide and set up virtual networks having their own machines and disk storage spaces and network level access control for those. There are more things as well that should be handled like data storage formation, Data integrity, VPC resource separation. Safety related precautions like use of encryption, IAM policies, legal provisions and clauses in peacekeeping task force handling with the capability of automation to deal with remaining challenges for cloud-based applications. I have added a feature to detect system metrics (such as running out of storage, CPU usage & response time) and also automatic scaling when it reaches the threshold. It involves Andy sort of building the real structured or unstructured data from various sources to assist in gaining insights and act as a driver towards decision making. Cloud computing allows you to enjoy growing data collection capabilities and relatively straightforward installation support with the many tools and connectors. object storage that stores unstructured data, blobs and files as objects. The secure data gets access between object storage based on an access control approach and other service which can also be this AES algorithm encryption implemented by cloud data management. In order to meet its performance goals, it works on better accessibility of data among teams and broad options of CNNs, RNNs, LSTMs for more complex tasks like video data processing image classification. whereas, using cloud platform we can scale it up to deploy CNN models at large scale or train RNN on big dataset to get correct predictions. Derivatives of RNN in deployment such as LSTMs it provides scalable resources and makes distributed computing (CNN, RNN and LSTM) in cloud such that we can able to training with distributed computing.

Table 1. Sample data.

Component	Description
Cloud Provider	Amazon Web Services (AWS)
Compute Instances	Elastic Compute Cloud (EC2) Elastic Compute Cloud (EC2)
Load Balancer	AWS Elastic Load Balancer (ELB)
Container Orchestration	Amazon Elastic Kubernetes Service (EKS)
Auto-scaling Configuration	AWS Auto Scaling
Real-time Analytics	Amazon Kinesis Data Streams
Data Processing	AWS Lambda, Amazon Glue

Phase 2 (Enhancement): Enhancing the Performance of Cloud- Infrastructure. One of the most important steps is to choose a cloud service provider (AWS, Azure, GCP) that fits the requirements of your system and create virtual networks, machines, disk storage, and set network restrictions Data storage pattern, data consistency, and VPC resource bifurcation are important points to be kept in mind. We take preventive safety measures such as encryption and IAM policies, comply with legal requirements, and automate cloud-based application challenges. Auto-scaling of system metrics (storage, CPU usage, response time) It is capable of capturing both structured and unstructured data for decision making available with scalable tools and connectors. Data is secured with object storage and AES encryption. They are also used to work on complex tasks, implemented using CNNs, RNNs and LSTMs both of which provide distributed computing and enables the training on huge datasets.

4 EXPERIMENTAL SETUP

The experimental setup helps to evaluate the performance of the cloud infrastructure.

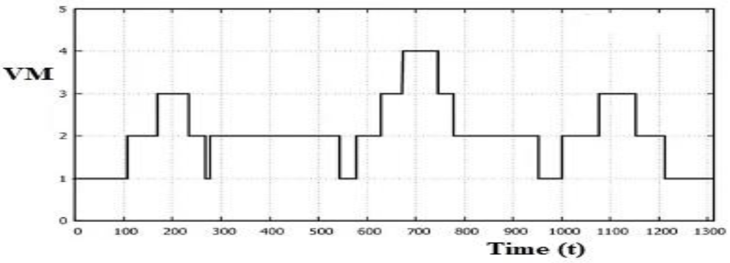

Figure 3. Number of VMs.

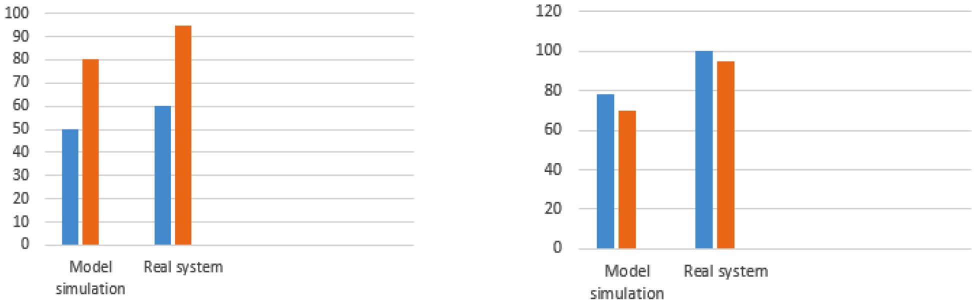

Figure 4 (a). Validation of throughput (b). Validation of VM usage.

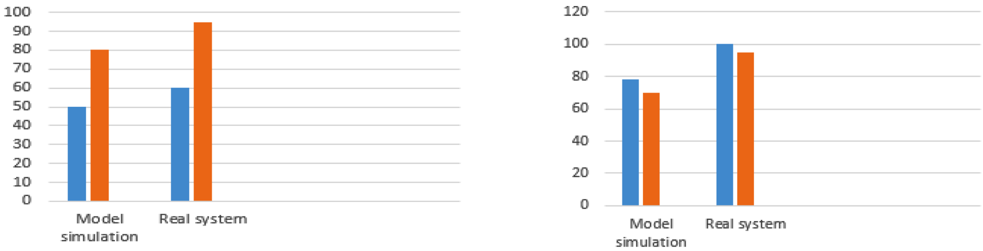

Figure 5 (a). Validation of throughput-Scenario 2. (b). Validation of VM usage-Scenario 2.

This helps to overcome the constraints in the dynamic scenarios with adopting optimal resource utilization. The integration of real-time data analytics with deep learning techniques helps in increasing the capability of the cloud infrastructures. This helps in extracting information from complex platforms to provide desired outcomes. This helps in adopting data-driven decision-making in real-time environments. The improved auto-scaling mechanisms help in improving the efficiency of the cloud infrastructure through adjusting the resource based on the fluctuating demand conditions. This helps in reducing the operational costs with increased performance parameters. upto 97% of the confidence level. 5B demonstrates the validation of VM usage. They are performed with a change of the inter-arrival time.

5 CONCLUSION

The modern computing systems infrastructural growth is based on cloud development. This helps to eliminate the Limitations in dynamic scenarios by using optimal resource utilization. Combining real-time data analytics with deep learning technologies permits the capability of many cloud infrastructures to be notably enlarged. It allows you to retrieve information from sophisticated systems that doesn't end up in the right hands. 14. Suitable for real time environment so decision makers can adopt data-driven decisions in real-time environments The aforementioned auto-scaling mechanisms lead to greater efficiency in the cloud infrastructure by dynamically scaling resources as per the varying demand conditions. This shall lead the decrease in operational cost and meets the enhanced performance parameters.

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Development of smart baby cradle system using IoT

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ABSTRACT: This paper describes the conception, creation, and deployment of a Smart Baby Cradle System with the goal of improving baby observation and alerting caregivers. The system monitors vital signs like temperature, humidity, sound by integrating a number of sensors and microcontrollers. When anomalies are found, real-time data processing and analysis allow caregivers to receive instant notifications through a mobile application. The system's hardware, data processing algorithms, alarm systems, and user interface design are all covered in this study. The outcomes of the experiments show how safe and dependable the Smart Baby Cradle System is for guaranteeing the security and welfare of new-borns.

Keywords: Baby observation, alarm systems, safe, security, real-time data, instant notifications

1 INTRODUCTION

For caretakers, protecting the health and safety of infants comes first, especially when they are sleeping or resting. Conventional baby monitoring techniques frequently lack the sophistication and real-time capabilities required to deliver all-encompassing care. We present the creation and application of a unique Smart Baby Cradle System as our solution to this problem. This system creates a strong platform for monitoring infants and notifying caretakers of any irregularities by integrating cutting-edge sensor technologies, real-time data processing algorithms, and caregiver notification systems. The Smart Baby Cradle System seeks to transform baby care by utilizing the most recent developments in sensor integration and data analysis. This will provide parents peace of mind and give babies a secure and cozy space to relax and sleep.

2 LITERATURE SURVEY

Joseph A.; Gautham J; A Kumar and M K Harish Babu, they suggested creating an Internet of Things-based Smart Baby Cradle system with sound, temperature, and gas sensors, among other sensors, along with a camera for live video monitoring. This system allows parents to remotely monitor and analyze their infant's activities, ensuring their safety and well-being from any location worldwide. The integration of IoT technologies and sensor modules enables real-time data collection and analysis to provide comprehensive infant care and protection. [1] Atul V Karanjkar; Rajeshwar Kumawat; they proposed an automated baby cradle system utilizing IoT technology for effective baby monitoring, featuring sensors for cry detection, mattress condition, and body temperature, controlled via a mobile application. Automation in the cradle aims to alleviate the burden on busy parents, allowing remote monitoring and care for their babies while balancing professional responsibilities [9]. S. Durga, S. Itnal, K. Soujanya, C. Z. Basha and C. Saxena, they proposed an IoT-based Smart Cradle system equipped with NodeMCU and sensors to monitor parameters such as crying, moisture, and ambient temperature, with automatic swinging functionality triggered

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by the baby's cries. Additionally, an external webcam enables continuous parental monitoring. [2] R. Sonia, S. M. Jayadeva, S. D. P. Ragavendiran, R. N, J. Arumugam and S. S. Kumar, they proposed an IoT-based Smart Cradle for neonatal monitoring, featuring input elements such as temperature, sound, and moisture sensors, controlled by a NodeMCU module and integrated with cloud storage for data analysis and parental notifications. This solution aims to address the challenges faced by working mothers in balancing childcare responsibilities with professional commitments. [10]. H. Chauhan, D. Gupta, S. Gupta and M. J. Haque they proposed a Smart system integrating IoT and Blockchain technologies to enhance infant monitoring in healthcare baby wards. This system aims to improve security measures and enable features such as alarm systems and real-time monitoring, reducing the burden on parents and healthcare staff. [3] Mahesh Kaluti, Kavana D, Nirbhay S URS, Sahana H, Harshitha K, they proposed an IoT and ML-based baby monitoring system integrated into a smart cradle structure, tracking room temperature, humidity, and baby's sound to automate swinging and fan operation, with emotion recognition and data storage on private cloud servers. This aims to address challenges in baby care faced by working families by providing real-time monitoring and automated responses. [11]

Varsha P Hotur; Adi Thejas N. R; Abhishek P; Chethan R; Adithya Bhatta B they proposed an IoT-based Baby Monitoring System integrated into a Smart Cradle, featuring features such as online streaming via camera, MP3 player for soothing music, and temperature and bed wet sensors embedded into an ESP32 microcontroller platform. The system utilizes high-speed internet for seamless IoT platform usage and sends SMS notifications via GSM to alert parents of any issues detected with the infant. [4] Santaji Krishna Shinde; J. Frank Vijay; S. Gomathi Meena; H. Roopa; S. J. Suji Prasad; S. Ramesh, they proposed an IoT-based Smart Cradle System with an intruder alert feature to enable constant monitoring and care for infants, aiming to prevent incidents such as the tragic case of an infant's death allegedly due to rat bites in a hospital neonatal unit. This innovative system ensures parents can remotely monitor their babies' well-being and safety, addressing concerns of inadequate infant supervision in healthcare facilities and at home. [12]

H. M. Ishtiaq Salehin, Q. R. Anjum Joy, F. T. Zuhra Aparna, A. T. Ridwan and R. Khan, they proposed an IoT-based Smart System for monitoring babies featuring automatic swinging of the cradle, detecting the sound of baby crying, lullaby playback, and diaper moisture detection, with notifications sent to parents via mobile calls and text messages. Additionally, the system incorporates face recognition technology using a Raspberry Pi 4 equipped with a Pi camera for live-streaming and real-time supervision of the baby via a webpage. [5] S. S. S. Susarla, S. R. Sadaf, S. K. Harshitha and N. Vijapur, they proposed an IoT and embedded-based smart baby cradle equipped with sensors, microcontrollers, and motors to provide gentle motion, wetness detection, and alert systems for parents, aiming to enhance infant care and parental convenience. By automating the cradle's motion for soothing and incorporating moisture-detection and sound detecting systems, the cradle creates a protective environment for babies while providing relief to parents. [13]

V. Suresh Kumar; Lokaiah Pullagura; Nalli Vinaya Kumari; S. Pooja Nayak; B. Padmini Devi; Adnan Alharbi, and Simon Atuah Asakipaam, they proposed a smart cradle equipped with video monitoring capabilities triggered by an infant's cry, automated swinging functionality, and alerts sent to parents via text message in case of prolonged crying or wet mattress. Additionally, the system features an automatic spinning toy for entertainment, catering to the needs of working parents seeking reliable infant care solutions. [6] A. Zhumabekova, N. Marat, N. Sagynbayev and M. H. Ali, they proposed the design and development of a smart electronic cradle, named "Baby NO CRY," which incorporates features to alter swing intensity and play lullabies based on the baby's cry amplitude, aiming to soothe and calm the baby effectively. By integrating a sound analyzing system to detect the infant's cry and adjusting swing intensity and lullaby volume accordingly, the cradle provides instant calming and restful sleep for infants, enabling parents to attend to other tasks without direct interaction. [14]

Sahil Lunawat; Aditya Adhduk; Vinaya Sawant; Ritik Sanghvi, “Smart Baby Cradle for Infant Soothing and Monitoring”,they proposed a smart cradle system equipped with a microcontroller for data collection, a mobile app for remote control and monitoring, and a cry detection module based on a neural network model. Utilizing servers of Amazon Web Services, the system offers advanced security features and high efficiency in assisting parents with newborn care. [7] Mohammed Najeebulla A; Najiya M P; Reema P; Ismail P K; Nidha K M; Mohammed Zahid K ,they proposed a Smart Baby Cradle System integrating IoT and machine learning for baby monitoring, featuring online streaming via camera, facial emotion recognition through image processing, and alerts for wet mattress or crying conditions. Embedded sensors, including a sensor for monitoring wetness of the bed and LDR (Light Dependent Resistor) sensor, enhance the functionality of the system, which can be controlled via a mobile app. [8]

3 DESIGN AND IMPLEMENTATION

The Arduino Nano, which serves as the system’s brain, is the first component in the Smart Baby Cradle System project’s methodology. It is externally positioned for ease of access and is in charge of taking commands from a variety of inputs and processing and carrying them out. Because of its flexible programming features, many components can be integrated with ease, promoting effective coordination and communication within the system. Furthermore, the Arduino Nano’s flexibility enables customization based on the needs and tastes of each unique user. The Arduino Nano serves as a mediator between components, enabling communication between the cradle and other systems or devices. It regulates the servo motor, which modifies the inclination of the cradle to provide the baby with the most comfort possible. In order to keep an eye on the baby’s health, sensors are essential. The DHT11 temperature and humidity sensor keeps track of the sleeping environment, while the moisture sensor finds damp diapers.

The sound sensor listens for the baby’s screams. It is crucial to have flexibility and responsiveness, which is accomplished by discretely integrating flex sensors that sense the baby’s motions inside the cradle. These sensors provide the Arduino Nano with real-time data, giving it insights into the baby’s activities and enabling adaptable reactions. By utilizing this feedback loop, the device permits customization according to specific needs while guaranteeing the baby’s safety and comfort. Through a smartphone app, caregivers may watch patients remotely and ensure timely intervention when needed. Real-time notifications are sent to them. The system promotes independence and enhances the overall caring experience by accommodating caregivers with varying backgrounds and skills through its inclusive design and user-friendly interface. The Smart Baby Cradle System is a comprehensive solution that effectively addresses the needs of both infants and caregivers, improving the quality of infant care via the painstaking integration of its components and functionalities. Block Diagram of Smart Baby Cradle System is shown in Figure 1.

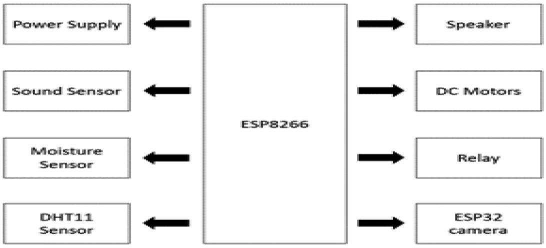


Figure 1. Block diagram of smart baby cradle system.

The ESP8266 serves as the central hub, connecting various components in the system. It is linked to a power supply, ensuring uninterrupted operation. The sound sensor and moisture sensor provide real-time data on the baby’s environment, detecting sound and wetness levels, respectively. The DHT-11 sensor surveils humidity and temperature conditions. A speaker is integrated to play soothing sounds or alerts as necessary. The DC motor controls the swinging motion of the cradle, promoting baby comfort. A relay facilitates the automated operation of the system. Additionally, an ESP32 camera enables live video streaming for remote monitoring of the baby's activities. Together, these components form a comprehensive smart baby cradle system, ensuring optimal care and monitoring of infants.

4 RESULT AND DISCUSSION

The Smart Baby Cradle System's ability to track an infant's vitals and send carers real-time notifications was proven during experimental testing. When anomalies like elevated temperatures, low humidity, or obstructions in front of the cradle are identified by the system, carers are promptly notified. The baby's vitals inside the cradle were precisely sensed by the sensors, allowing for responsive actions that guaranteed the infant's security and comfort. In response to sensor inputs, the motor changed the cradle's angle of inclination, putting the infant in the best possible position for rest. Additionally, the mobile app allowed for remote monitoring and intervention. Overall, it was shown that the Smart Baby Cradle System has the ability to improve carer response and newborn monitoring techniques, which will benefit infant safety and well-being in childcare environments. To maximize the system's functionality and performance in practical applications, more testing and validation via larger-scale research and user input is necessary. Prototype and user interface of the app are shown in the Figures 2 and 3.

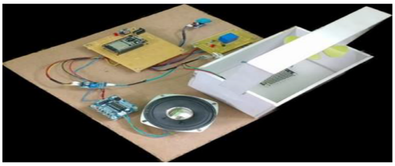
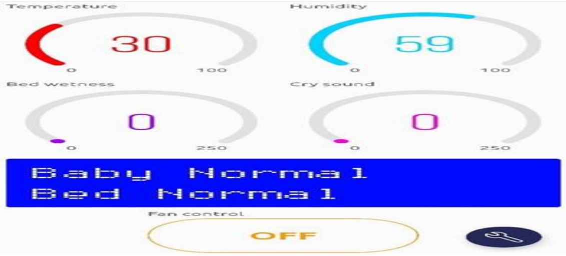


Figure 2. Prototype.



Temperature 30

Humidity 59

Bed wetness 0

Cry sound 0

Baby Normal
Bed Normal

Fan control OFF

Figure 3. User interface of the app.

The prototype portrays the sensors like sound sensor which is connected to a speaker, moisture sensor, DHT-11 sensor. The camera is mounted on the top of the cradle to get the baby's view. The DC motor swings the cradle as per the need of the caretaker. This system is connected over the Wifi to enable remote interactions. The UI of the app is made simple to interact with and displays every detail specified. As per the insights gained through the sensors, we can control the system to act in favour of the baby.

5 CONCLUSION AND FUTURE SCOPE

In conclusion, the "Smart Baby Cradle System" offers a complete solution for keeping an eye on babies and giving caregivers real-time alerts. The system successfully optimizes infant monitoring practices and improves caregiver response by integrating modern sensor technologies, real-time data processing algorithms, and caregiver notification systems. Infant safety and wellbeing at daycare facilities are guaranteed by the system's adaptive reflexes and capacity to identify anomalies like temperature swings, humidity levels, and obstructions in front of the cradle. Furthermore, the system's inclusive design and user-friendly interface support caregivers with varying backgrounds and skill levels, promoting freedom and enhancing the overall experience of providing care. Even with these developments, more study and research are required to maximize the system's functionality and performance in practical applications. Future iterations of the Smart Baby Cradle System have the potential to greatly alter infant care practices and enhance outcomes for both infants and caregivers by utilizing emerging technologies like AI and taking user feedback into account.

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Empowering troop safety with advanced position and health monitoring using LoRa

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ABSTRACT: The novel conceptual representation involves the integration of long-range transmission technology LoRa that boosts soldier surveillance operation in air, water and land domains. It tracks vital signs like heart rate, pulse, body temperature and movement, which are key metrics to identify fatigue of soldiers at war. As well, an inductive proximity sensor can improve metal detection. The combination of all these effects supports efficient tracking of soldiers and monitoring of parameters and may lead to an improvement of survivability. This system shows a breakthrough model that as security sector looks to sophisticated improvements in operational efficiency for protecting warriors worldwide 21st-century military tracking capabilities.

Keywords: LoRa, health monitoring, soldier tracking, survivability

1 INTRODUCTION

In modern warfare, it is essential to improve the safety of the troops by implementing advanced tracking and monitoring technologies on their bodies. The integrated system provides commanders and medical personnel with a full view of the situation. Real Time soldier tracking allows quick battlefield awareness as well as the efficient use of the resources born out of that towards quick response. By doing so, this measure is destined to change the landscape of military activities, providing an increase in safety and operational efficiency in every domain.

2 LITERATURE SURVEY

Wireless Sensor Network for monitoring soldiers' strongness and proficiency is an area of critical interest in the field of defense. Numerous researchers have endeavored to develop advanced systems to track and analyze the health and performance of soldiers in real time. The integration of wireless sensor technologies in wearable devices has enabled the creation of innovative solutions for monitoring soldier well-being and efficiency. A publication by N. Sriraam, S. Vinay Kumar, M. Niranjan, and R. Mohan Kumar titled "Development of a LoRa-Based Wearable Physiological Monitoring System for Healthcare and Military Applications" showcases the potential of using LoRa technology for health monitoring in military settings. This system highlights the importance of accurate and timely data collection for assessing soldiers' physical condition in challenging environments. Similarly, a study by Yunus Emre Harmancı, Alper Sinan Akyürek, Ayça Çakmak, and Ramazan S. Aygün presents a real-time health and position monitoring system using wireless body sensor networks for soldiers. This research, published in the MDPI Sensors Journal, offers valuable insights into enhancing soldier safety and operational readiness through IoT-enabled monitoring systems. Furthermore, research conducted by Y. P. V. S. Sai Prasad, N. Venkata Kishore, and K. Jaya Sankar investigates the implementation of IoT technology for military health monitoring. Their work, featured on ResearchGate, focuses on leveraging wireless

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sensor networks to ensure continuous monitoring of soldiers' health status and location information. Another research study by Sandeep Ch, V. Rajinikanth, and V. Bharathi delves into the development of an IoT-enabled military health monitoring system utilizing LoRa technology. This study, available on ResearchGate, emphasizes the significance of integrating advanced communication technologies for ensuring seamless connectivity and data transmission in military health monitoring applications.

3 PROBLEM DEFINITION

The trooper's equipment list includes body warmth, oxygen, AQI sensors, speakers, microphone, buzzer, anxiety key, LCD, GPS and Wi-Fi unit, all tethered together over Arduino. Client-server aspects are not yet able to communicate As such, the goal of enhancing a framework is to fundamentally re-implement the framework to an extent where its functionality and reliability can be improved.

4 PROPOSED SYSTEM

A proposed system has been introduced intentionally, to enhance the surveillance and support of soldiers across air, water, and land domains relatively. This system is designed uncommonly to be attached to soldiers, enabling the monitoring of their health parameters and locations, imagine that Leveraging the Long Range (LoRa) technique, signals can be transmitted second hand over vast distances from the soldier to the control room really, boasting low data rates indeed The implementation of LoRa ensures efficient power consumption alongside high transmission power. The health monitoring system encompasses heart rate, pulse, temperature, and motion detection which is kind of crucial for Lol assessing soldier fatigue levels in combat zones you know. Furthermore, the system integrates an Inductive proximity sensor to bolster metal detection capabilities. That is an interesting choice indeed. By amalgamating these components, effective soldier tracking and many parameter monitoring are achieved, possibly enhancing their survivability. Across the globe conveniently, the security sector seeks mind-blowing technologically advanced solutions to safeguard soldiers and boost their operational effectiveness. This innovative monitoring system represents a significant stride in meeting these interesting objectives.

4.1 *Advantages of the proposed system*

Less complicated than the exist system, Low cost and easy to be mounting, High securities and long coverings and It consumes low power and does not require any forms of networks.

4.2 *The algorithm*

Each body parameters (temperature, heart rate) are monitored using LM35 and pulse sensors by the transmission of details to the control center. Gas and metal sensors, location tracking to detect hazard and send alert base station. This system enables a rapid response to critical situations while serving as a clear example of surveillance solutions, and ensuring the security situation.

4.3 *Soldier's node*

The soldier's Body Sensor Network (BSN) includes a [temperature sensor] for accurate measurement of human body and surrounding air temperature along with RC-A-4015 [pulse sensor] for BPM rate. This report will enable you to receive immediate alerts for prompt actions if incoming data deviates from previously defined thresholds. BSN with RF receiver is used to monitor the soldier's fixed zone, the sensor data is processed and is stored in a secured manner through a microcontroller and then transmitted with a LoRa transceiver module. There are environmental issues and all kind of interference that make it hard to monitor and transmit data accurately (3). Block Diagram of the System and System in Operation: Figures 1 and 2.

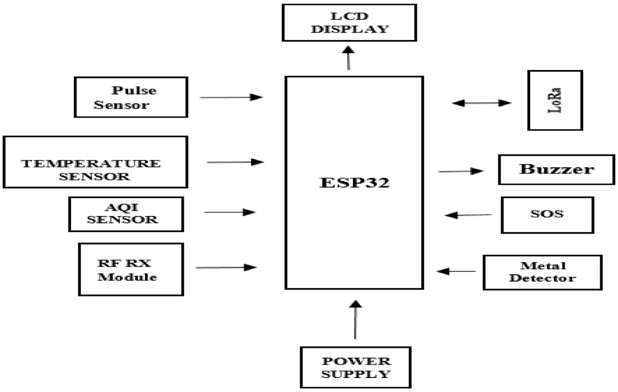

Figure 1. Block diagram of the proposed system.

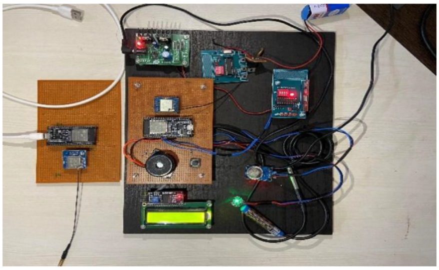

Figure 2. Proposed prototype in action.

4.4 *Control node*

This node (Figures 3 and 4) has an SX1278 wireless RF LoRa module, which is where it gets data from the other nodes. This node's sole purpose is to track, archive, and analyze the information received from the node. The ThingSpeak web application is also used to connect this node to the internet. We can link this node to the internet with the use of a USB, and a laptop. When this node is online, data from sensors is delivered to the ThingSpeak cloud and simultaneously sent to the dashboard designed to communicate with the project through the cloud.

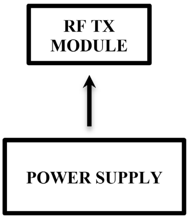

Figure 3. Subnode.

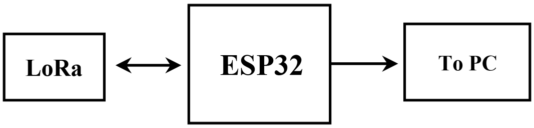

Figure 4. HUB (Control room).

5 LoRa UNIT

LoRa units, typically consist of a transceiver module, something like a transmitter-receiver that enables communication between devices using LoRa modulation. They operate in unlicensed radio frequency bands, unlicensed bands, you know what I mean, providing a cost-effective and efficient solution for a wide range of applications, like seriously wide, such as smart cities, agriculture, industrial monitoring, and asset tracking.

5.1 *Key features of LoRa units include*

5.1.1 *Long range*

LoRa technology enables communication over several kilometers in urban environments and up to tens of kilometers in rural areas, like really far, depending on factors like antenna placement, oh and also environmental conditions, of course.

5.1.2 *Low power consumption*

LoRa units are designed for low power operation, making them kinda of right, suitable for battery-powered devices that need to operate for extended periods without frequent battery replacement, which is super convenient.

5.1.3 *Secure communication*

LoRa technology includes built-in security features to ensure secure communication between devices, protecting against eavesdropping, which is like really not good, and unauthorized access, like who wants that!

5.1.4 *Scalability*

LoRa networks can support thousands, yes thousands, of devices within a single network, making them highly scalable, like scalable, for large-scale IoT deployments, sounds impressive

Overall, LoRa units provide, like seriously provide, a reliable and cost-effective solution, yeah, for long-range wireless communication in IoT applications, offering a balance between range, power consumption, and scalability.

6 METHODOLOGY

Wireless RF modules are then used to transfer the data gathered from the sensors (current position) to the following level of the hierarchy. This technology enables the control room unit to use the wireless body sensor network and the RF receiver at regular periods to continue tracking the position and monitor the troops' vital signs. As part of the suggested architecture, an ESP8266 connected to the control room continuously checks the data received from the various subsystems and issues an alert if any values go over or below predetermined thresholds. The soldier's whereabouts and live health status are tracked to guarantee their safety on the battlefield, and if any irregularities are discovered in the values supplied to the control unit node, they make sure that help is delivered from that node or the squadron leaders node as soon as possible.

7 RESULT

7.1 *Position tracking*

Real-time positions of troops are plotted on a map, with each troop being represented by a marker. And so, the map could potentially potentially display terrain features and troop movements in different colors to indicate speed or direction. Historical movement patterns of troops over some time are shown as a line graph, with timestamps on the x-axis, and coordinates on the y-axis, making it a bit easier to follow. Each troop's path could potentially be represented by a different line.

7.2 *Health monitoring*

Military healthcare is dependent on collecting and evaluating data to monitor the vital signs of the soldier. Core vital signs including heart rate, temperature, and blood pressure are reported in graphical line representation over time. Analyzed data is summarized through bar graphs and pie charts and underlying statistics are explained about such as, mean heart rate, and the proportions of abnormal detected readings among the whole troops. This exhaustive analysis helps medical staff recognize health trends and intervene as needed before the health of service members become more serious.

7.3 *Operational efficiency*

In a military context, troop health significantly affects the success of a mission and the operational effectiveness of a force, while influencing mission duration and planning. Advanced location tracking tech saves mission time with its real-time position monitoring keeps in check the health and locations of the troops. The graphical representations of Figure 5 show the relationship between health metrics and mission outcomes, which is especially valuable in that it can help leadership make the strategic decision regarding renegotiating a milestone.

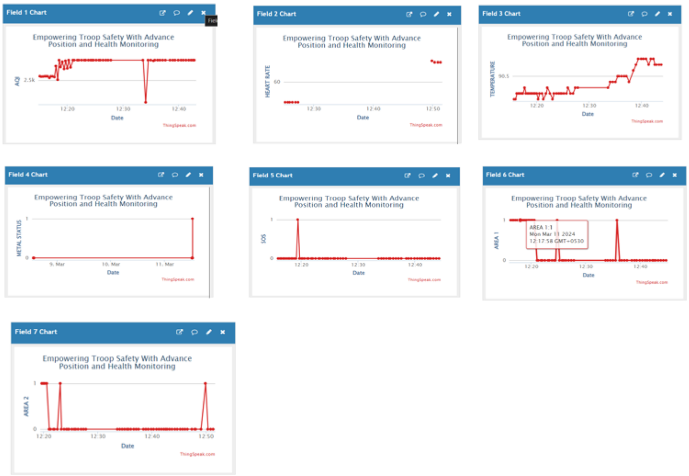
Field 1 Chart
Empowering Troop Safety With Advance Position and Health Monitoring
AQI
2.5k
12:20
12:30
12:40
Date
ThingSpeak.com
Field 2 Chart
Empowering Troop Safety With Advance Position and Health Monitoring
HEART RATE
60
12:30
12:40
12:50
Date
ThingSpeak.com
Field 3 Chart
Empowering Troop Safety With Advance Position and Health Monitoring
TEMPERATURE
90.5
12:20
12:30
12:40
Date
ThingSpeak.com
Field 4 Chart
Empowering Troop Safety With Advance Position and Health Monitoring
METAL STATUS
1
0
9. Mar
10. Mar
11. Mar
Date
ThingSpeak.com
Field 5 Chart
Empowering Troop Safety With Advance Position and Health Monitoring
SOS
1
0
12:20
12:30
12:40
Date
ThingSpeak.com
Field 6 Chart
Empowering Troop Safety With Advance Position and Health Monitoring
AREA 1
1
0
AREA 1: 1
Mon Mar 11 2024
12:17:58 GMT+0530
12:20
12:30
12:40
Date
ThingSpeak.com
Field 7 Chart
Empowering Troop Safety With Advance Position and Health Monitoring
AREA 2
1
0
12:20
12:30
12:40
12:50
Date
ThingSpeak.com

Figure 5. Output representations.

8 CONCLUSION

Our project successfully implemented advanced positioning and health monitoring by leveraging LoRa technology for military purposes, bringing a significant enhancement to troop safety and operational efficiency.

Here are some key highlights:

- Enhanced Awareness: Through real-time tracking, commanders gain a clear understanding of troop movements, assisting them in making well-informed decisions during missions.
- Ensuring Troop Safety: Continuous health monitoring facilitates early detection of health issues, thereby decreasing the likelihood of serious incidents during operations.
- Response Speed: Thanks to LoRa's rapid communication capabilities, emergency responses can be executed swiftly, leading to minimized risks and ensuring troop safety.
- Boosted Efficiency: Utilizing the collected data enables commanders to better plan and execute missions, resulting in improved outcomes.

In the forthcoming, we are striving to further enhance the system, potentially by integrating machine learning or linking it with additional military systems. Our primary objective remains focused on safeguarding troops and achieving precision in mission completion under any circumstances.

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Enhanced kitchen safety system

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ABSTRACT: This kitchen system, NodeMCU ESP8266-based automated kitchen system uses state-of-the-art techniques for the people who want an easier and safe living, it will also maintain real-time data with sensors and servo motors (Temperature, Humidity, Gas level, Air quality). The proactive system will result in instantaneous gas valve response in order to prevent potential accidents, leading the industry once again in new kitchen safety standards. This advancement is distinct from standard detection systems that depend on cameras or alarms, because it puts the focus on preventative safety features. Its implementation stands as a paradigmatic application of a MOVEABLEtype service that supports a new vision of proactive kitchen safety; it thus not only improves user safety at all times during normal cooking activities, but also it can prevent hazards from occurring in the first place.

Keywords: IoT, Kitchen, Automation, MQ-3

1 INTRODUCTION

This is an Enhanced Kitchen System Using IoT made with sensor nodes and it also contains relays managing Live Holography through Blynk app in NodeMCU ESP8266. Driven by technological innovation, this visionary setup guarantees safety and efficiency. Remotely monitor humidity, temperature, gas levels (DHT11 and MQ-3 sensors), and will alert you with a buzzer sound within your home – via Blynk. The instant gas detection provides a sense of security one would think of as verging on the brink of desperation. The system's servo motor also reacts immediately to the existence of gas, which proves its proactive safety measures. This smart kitchen running on IoT not just supports making work easy also it changes the house threats by guiding you in real-time and serving the responsive automation.

When MQ-3 sensor detects the presence of gas, the servomotor is meant to start operating. It uses its accurate and controlled motions to trigger the gas valve shutting it off fast just in case any possible danger may be caused by it. Our polished integration of technology into this includes not only an upgrade for our gas detection system's efficiency but also a reassurance that we have created a safe responsive environment for users. Here is how our journey looks like when we go through these different sections including sensor calibration, hardware setup, programming intricacies, safety features and user-centric functionalities. Tomorrow's kitchen will come out from all these pieces where every minute detail adds up to form something intelligent that can think back at you and perhaps beyond everything else make you secure in mind.

Almost 1800 deaths went unnoticed for the carbon monoxide poisoning in India in the year 2021 because of its sleuth air. The human burns are a global issue with great historical roots, ergo all the elderly people who suffer children in their domestic kitchens, and therefore the importance of prevention, fire mitigation measures. House security is still an important aspect of the changing scenario of modern India given the rising threat of burglary and break-ins. Indoor air pollution contributes to significant disease burden, particularly from use of traditional cooking fuels, leading to calls for better ventilation, and use of cleaner energy. Accidental burns, especially involving young children, are a major contributor to injuries and subsequent long-term health effects across the country.

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2 LITERATURE SURVEY

The authors in [1] identified an IoT-based smart kitchen system using sensors such as DHT11, MQ-135, IR flame and PIR to monitor temperature gas leakages, fire outbreak and human movement. It's controlled by Arduino Uno and ESP8266-01 that respond to changes with the help of activating a fan and setting off alarms as well as sending notifications via the Cayenne server to mobile devices. The tests affirmed precision of sensors, live data presentation on the Cayenne dashboard as well as immediate warning during simulated emergencies pointing toward improved safety in kitchens along with remote surveillance. Researchers in [2] introduced an IoT-based Smart Kitchen System addressing LPG safety by monitoring gas, flame, humidity, and temperature using an Arduino UNO. It tracks leaks, fire outbreaks, cylinder weight, and environmental conditions. Alerts via email and alarms are triggered for gas leaks or fires using gas and flame sensors, load cells, LEDs, and buzzers. [3] Internet of Things (IoT) Smart and Safety Monitoring System for Kitchens I hereby present an IoT-based Smart and Safety Monitoring System for kitchens as a means of preventing cooking accidents such as fires, gas leaks etc.

The system is equipped with temperature sensors like DHT11, flame sensor modules such as IR flame sensor or gas leakage detector like MQ-3. Sensor integration and data transfer are facilitated by Arduino UNO and ESP8266 through Wi-Fi. Based on [4], this study introduces another IoT-based monitoring systems for both industry safety and kitchen environment sensed with gas leakage, fire outbreak, high-temperature detectors etc. A controller circuit sends information to cloud for analysis and automation that activates SMS alerts or alarms in times of danger. It is seen as a protection against danger by enabling remote control which helps mitigate risks thus saving lives as well as properties in diverse locations across the globe. The aim of the authors [5] was to establish the implication of IoT in kitchen as well as furniture manufacturing, and emphasize on the necessity for skilled adaptation to meet technical requirements. The article concentrates on safety assurances by IoT for example gas leaks detection, and challenges that face traditional enterprises. Moreover, it describes a smart system for cooking with internet of things with embedded sensors and microcontroller for gas concentration alert systems. In their study [6], the researchers presented a kitchen safety system based on NB-IoT, which can be remotely monitored and controlled via an Android application.

Gas, flame, temperature among others is detected by sensors before being transmitted to the app for real-time analysis. Sensor modules, NB-IoT communication unit and relay controls constitutes hardware while MCU programming is involved in software together with server-side operations for data storage and an android application designed for visualization plus control purposes. Article [7] discusses 'DeepSafe,' a kitchen safety system driven by the internet of things (IoT) and uses embedded devices as well as sensors to detect gas leakage, abnormal fire, and vibrations. It incorporates deep learning for accurate fire detection and comes with a servo motor for auto gas source shut off. This allows users to monitor remotely via smartphones as they have live control over kitchen safety. In [8], authors examine integration of IoT in smart kitchens for safety purposes using sensors such as CO2, pressure, temperature connected on Arduino Uno board. It stresses remote monitoring; text message alerts about gas leaks; automatic cloud or mobile app controls. The authors show how their study was successful but also suggest that dual power supply is needed as an improvement while other sensor capabilities may need to be expanded in future works. The report by authors in [9] presents IoT-oriented real-time kitchen monitoring system concentrating on safety and efficiency issues.

It contains gas, temperature and humidity sensors with actuators that allow manipulation of appliances at a distance. To stress the importance of being instantly informed about all alerts, it ensures expeditious combating against such hazards as leaking gas to improve the overall user's security. In article [10], smart kitchen systems based on IoT technology are discussed targeting automation and monitoring aspects. With sensors for gas, temperature etc., it enables real-time control of devices through an IoT platform for home appliances. The design of the remote monitoring system includes user-friendly interfaces for effective management inside any kitchen space.

3 METHODOLOGY

System Architecture of our project is given in Figure 1a. It shows the architectural flow of how the system works. The safety of the kitchen environment is continuously monitored as shown in the Figure 1b. The system operates on a client-server architecture with the ESP8266 acting as the client and the Blynk app as the server. Sensor data (DHT11: analogue, MQ-3: analogue, HC-SR501: digital) is transmitted via WiFi to the Blynk app for real-time visualization and analysis. The ESP8266 receives commands from the app to control the gas valve (shutting down the gas valve). Also the user is alerted through an email regarding the gas leakage. Figure 1a shows the block diagram of the system where the necessary sensors are integrated to monitor the safety of the kitchen environment in real time.

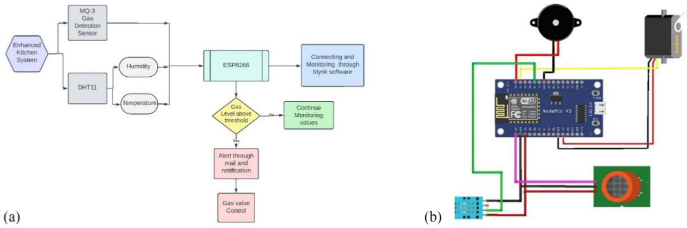

MQ-3 Gas Detection Sensor
Enhanced Kitchen System
Humidity
DHT11
Temperature
ESP8266
Connecting and Monitoring through blynk software
Gas Level above threshold
No
Continue Monitoring values
Yes
Alert through mail and notification
Gas valve Control
(a)
(b)

Figure 1. (a) Architecture of the proposed system. (b) Block diagram of the system.

Algorithm 1: Algorithm to monitor the kitchen environment

Input: *Blynk authentication token (auth), Wi-Fi credentials (ssid, pass), MQ-3 sensor pin (mq3Pin), buzzer pin (buzzer_alarm), servo motor pin (servoPin), DHT sensor type (DHTTYPE), DHT sensor pin (DHTPIN)*

Output: *Gas leakage status, temperature, humidity, and sensor readings displayed on Blynk app*

```
Initialize: Include necessary libraries.
Define Wi-Fi credentials, Blynk authentication token, and pin assignments.
Create objects for DHT sensor and servo motor.
Setup: Begin serial communication.
Start DHT sensor.
Connect to Wi-Fi and Blynk server.
Set pin modes for buzzer, relay, and servo.
Initialize relay and buzzer states.
Attach servo to designated pin and set initial position.
Loop: Continuously execute the following steps:
    Handle Blynk communication.
    Read sensor values from MQ-135 (gas sensor) and DHT (temperature and
        humidity).
    Check gas sensor value: If gas level exceeds threshold (200):
        Trigger alarm (activate buzzer).
        Turn off gas valve (via relay).
        Rotate servo to 180 degrees.
        Send alert to Blynk app and also mail to the user.
    Else (gas level normal):
        Deactivate alarm (turn off buzzer).
        Turn on gas valve (via relay).
        Rotate servo back (optional).
    Print sensor readings to serial monitor.
    Send sensor readings to Blynk app.
    Wait for 2 seconds before repeating the loop.
End Loop.
```

Sensor Data: The DHT11 sensor measures temperature and humidity with extreme precision, sending them as floating-point numbers via the I2C protocol, a popular communication standard for electronic devices. The MQ-3 gas sensor watches vigilantly for the level of concentration of gases (as a floating-point number) and simultaneously calculates the Gas Index as an integer to measure interest. It utilizes Analogue-to-Digital Conversion (ADC) technique in order to change analogue sensor reading to digital signals for microcontroller communications.

Control Commands: The Blynk App becomes a user-friendly interface that allows monitoring temperature, humidity and gas levels using ESP8266 microcontroller while also sending out alert notifications. This is done by means of Wi-Fi socket connection which totally provides wireless control.

Hardware Configuration and Programming: Acquiring necessary components, assembling the system: Building it on a breadboard. Ensuring that all components are connected correctly with utmost precaution to their respective data sheets for precision and functionality.

Programming the ESP8266 microcontroller: Using the Arduino IDE carefully program it so that it does exactly what is expected of it in terms of; obtaining data from sensors then processing this information.

Wi-Fi Communication: Establishing strong communication with Blynk app through Wi-Fi connection for data exchange as well as remote control.

Relay Control: Relay Control of activation and deactivation must be based on the defined threshold values and user controls via Blynk application.

Sensor Calibration and Testing: For perfect readings of temperature and humidity, DHT11 sensor must perfectly computed. Similarly, calculation is required for accurate gas level detection and air quality index using MQ-3 sensor.

Integration and System Validation: By connecting each component in line with the specified architecture, the system was put together. The ESP8266 microcontroller was programmed to perform its designated tasks after the developed firmware was uploaded to it. Thorough testing was carried out to put the system through a thorough assessment, guaranteeing its dependability and functionality. This includes: Verifying the accuracy and consistency of sensor data readings. Validating servo control operations based on both sensor thresholds and user input. Testing the seamless connection and visualization within the Blynk app.

4 IMPLEMENTATION

Table 1. Hardware details of the enhanced kitchen safety system.

Table 1. Hardware details.

Component	Technical Specification
ESP8266 NodeMCU	CPU: Tensilica Xtensa LX2, 80 MHz clock speed, 32 KB RAM, 4 MB Flash; Wi-Fi connectivity
DHT11 Sensor	Operating voltage: 3.3-5V, Humidity range: 20-80%RH, Accuracy: ±2°C for temperature, ±5%RH for humidity
MQ-3 Gas Sensor	Operating voltage: 5V, Sensitivity: 20mV/ppm, Detection range: 0-10,000 ppm, Output: Analog voltage
Buzzer 5V	Operating voltage: 5V, Sound pressure: 80-90 dB, Frequency: 2900 Hz
Servo Motor	Operating Voltage is +5V Torque: 2.5kg/cm Operating speed is 0.1s/60° Gear Type: Plastic Rotation: 0°-180° Weight of motor: 9gm
Jumper Wires	Varied gauges and lengths to suit different connections
Breadboard	Mb102 breadboard, 165 × 55 × 10 mm, 95 gm,830 tiepoints

Deployment and Evaluation: A real kitchen will be used to install the kitchen safety system, and it will undergo extensive testing over a long period of time. Monitoring will be done by putting the functionality and dependability to the test in various scenarios. Input from users and performance analysis will be used to improve and update the system, as well as gather feedback on the user experience. Figure 2 shows the implementation of the enhanced kitchen safety system.

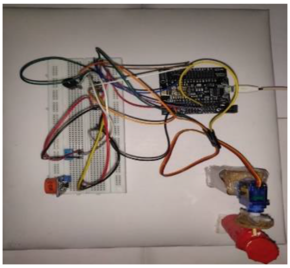
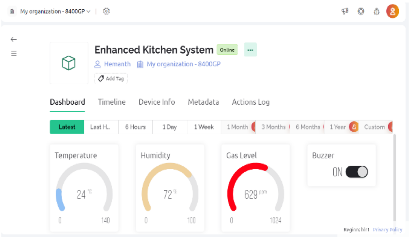


Figure 2. Implementation of the system.



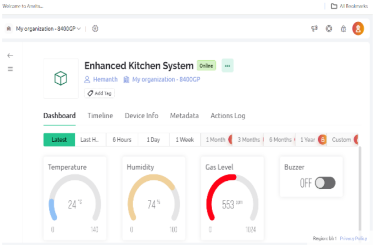
Temperature 24 °C

Humidity 72 %

Gas Level 629 ppm

Buzzer ON

Figure 3. Blynk application when gas leakage not detected.



Temperature 24 °C

Humidity 74 %

Gas Level 553 ppm

Buzzer OFF

Figure 4. Blynk application when gas leakage is detected.

5 RESULTS AND ANALYSIS

In real-time, the Temperature, Humidity, Gas level, and alarm status (Buzzer) can be viewed on Blynk. Real time monitoring of the kitchen environment can now be done through Blynk application [1]. The Figure 3 below shows Blynk user interface when there is no gas leakage detected in the kitchen environment. Gas levels are under threshold value & ALARM STATUS remains OFF. While on Figure 4 depicts Blynk App interface showing gas leak detection. Gas levels are above threshold value while the alarm status indicates an ON state. By shutting off the gas valve and sending an email and notification to the user about this kind of leakage.

6 CONCLUSION

The different sensors DHT11, MQ-3 gas Sensor can be integrated with node MCU ESP8266 to create an IOT based enhanced kitchen safety system. This system helps in monitoring the real time environment of the kitchen using the Blynk application and increase the safety of the kitchen. This helps prevent potential kitchen hazards, especially gas leakages and fires by taking the necessary safety measures in real time. This system can be found helpful and simple to implement with the lowest cost. For Future work machine learning algorithms can be implemented to predict the kitchen hazards.

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Enhancing sustainability and efficiency through automation and wireless sensor network-controlled irrigation system

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ABSTRACT: The Wireless Sensor Network (WSN)-controlled irrigation system integrated with Machine Learning (ML) and Genetic Algorithm (GA) demonstrates efficient water management in agriculture. This is implemented using the wireless sensor nodes that are placed in the agricultural field to monitor various environmental factors which involve temperature, moisture and humidity. They help in the continuous collection of data and transmit them wirelessly. This helps in real-time monitoring and control. The automatic decision-making process of the irrigation system is done using machine learning techniques. They help in analysing the huge amount of data in the WSN. The ML algorithms help to detect various abnormalities and trends that help to provide optimized irrigation schedules based on the particular requirements of the crops. This intelligent system helps in the prediction of optimal irrigation timings and water quantities. The accurate irrigation strategies are obtained using a genetic algorithm. This is evolved using selection, crossover and mutation processes. These parameters help to improve the water usage efficiency with enhanced crop yield. This helps to ensure that the right amount of water at the right time is irrigated without wastage. Thus the integration of ML in a WSN-controlled irrigation system helps to overcome various constraints of the agricultural environments through providing adaptive solutions.

Keywords: Wireless Sensor Network, Machine learning, Genetic Algorithm, Environmental factors, Decision-making techniques, Adaptive solution

1 INTRODUCTION

Irrigation systems are crucial for agriculture, enhancing productivity and ensuring timely water distribution to crops. Surface irrigation and drip irrigation are common types, with the

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latter reducing water waste. Efficient irrigation systems help farmers in areas with low rainfall, preventing floods and droughts while optimizing resource use and saving water. Artificial intelligence (AI) plays a key role in developing sustainable irrigation systems by addressing the inefficiencies of traditional methods and providing intelligent solutions through smart sensors and data analysis. AI predicts irrigation needs accurately, adapting to changing environmental conditions using machine learning algorithms for continuous learning and optimization. This innovation enhances agricultural productivity and sustainability, offering new solutions to overcome challenges in adopting renewable energy systems (Rao *et al.* 2023 [1]).

AI-driven irrigation systems in agriculture improve water management, resource optimization, and crop protection, contributing to the advancement of sustainable practices in farming (Pagano *et al.* 2023 [2]; Wu *et al.* 2023 [3]). These systems enable real-time monitoring and decision-making, significantly enhancing the efficiency and effectiveness of water usage in agriculture (Vandôme *et al.* 2023 [4]). By incorporating advanced technologies like the Internet of Things (IoT), AI can provide precise irrigation schedules and detect anomalies or system failures, ensuring consistent and adequate water supply to crops (Jihani *et al.* 2023 [5]).

Overall, AI-driven irrigation systems represent a significant step forward in sustainable agriculture, promoting better water management and resource optimization while protecting crops and enhancing yields (Nramat *et al.* 2023 [6]; Estrada-López *et al.* 2023 [7]). These innovations are essential for addressing the global challenges of water scarcity and food security, ensuring that agricultural practices remain viable and productive in the face of changing environmental conditions (Romanov *et al.* 2023 [8]; Kumar *et al.* 2023 [9]).

2 EXISTING SYSTEM

The existing system in the irrigation practices is implemented using the Internet of Things (IoT) only. This involves various drawbacks as listed below.

- One of the significant drawbacks involves various potential threats. When the irrigation system is interconnected through IoT results in various malicious attacks results in hacking and data breaches. They lead to various risks in the functioning of the irrigation system.
- The dependence on IoT in irrigation systems leads to the need for reliable internet connectivity. When the internet infrastructure in certain regions is relatively low, this results in poor efficiency in the irrigation system.
- The initial cost of implementation of IoT-based irrigation systems is higher. They involve sensors, actuators and various communication protocols. This causes various inequalities in the irrigation systems.
- Various environmental concerns may be involved due to the integration of IoT in irrigation systems. The production and disposal of various electronic components result in the wastage of raw materials. This results in an increase in global e-waste.

To overcome these drawbacks, the proposed system is implemented to obtain improved efficiency.

3 PROPOSED SYSTEM

The proposed system aims to provide an efficient irrigation system using wireless sensor networks and machine learning techniques. It includes components such as wireless sensor nodes distributed in the field, a central control system, and wireless communication infrastructures. Genetic algorithms are used to optimize irrigation management strategies based on collected data. The system offers solutions based on defined goals and uses a graphical interface for user monitoring and control. Solar panels are used for energy collection, and historical data is stored for future optimization. The system helps automate decision-making processes for determining optimal watering schedules and controlling irrigation equipment. Overall, the system integrates various technologies to improve crop health and productivity through effective irrigation management.

4 IMPLEMENTATION OF THE PROPOSED SYSTEM

The proposed system is implemented using various stages integrating optimization techniques as described below.

4.1 *Wireless sensor network (WSN)*

A wireless sensor network (WSN) is a network of interconnected devices that communicate wirelessly to monitor and collect data from the environment. Sensors such as temperature, humidity, light, and soil moisture sensors are used in WSNs to collect various types of data. WSNs are designed to be deployed in challenging environmental conditions and remote locations, making them suitable for a wide range of applications including industrial, environmental monitoring, and health systems. Various communication protocols are used in WSNs to ensure efficient data transmission and security. In wireless irrigation systems, sensors are deployed in agricultural fields to collect real-time data on factors such as soil moisture, temperature, humidity, and crop health. This data is used to optimize water use through automated decision-making technologies. The sensors communicate wirelessly with a central information management system to process data and make decisions regarding water distribution. Unmanned aerial vehicles (UAVs) are also used for data collection in large agricultural areas. Overall, WSNs and wireless irrigation systems play a crucial role in collecting and analyzing data to improve efficiency and decision-making in various applications.

Table 1. Data analysis.

Location	Sensor type	Soil moisture (%)	Temperature Degree (Celsius)
North Field, Row 1	Soil Moisture	12	20
South Field, Row 3	Weather sensor	15	21
East Field, Row 2	Soil Temperature sensor	19	20
West Field, Row 4	Soil Moisture	22	19
Central Area	Weather	19	17

Table 1 demonstrates the data analysis of various sensor deployments at a particular agricultural field in a nearby village.

4.2 *Data acquisition and processing*

Data collection involves gathering information from sensors to determine soil moisture and environmental conditions. This data is processed to make decisions, such as establishing a watering schedule and predicting future irrigation needs. Wireless communication allows for continuous data transmission between nodes and the central control unit, providing flexibility and remote control capabilities for managing the irrigation system effectively.

4.3 *Structure of genetic algorithm*

Genetic algorithms (GA) are used in automated irrigation systems to optimize crop irrigation programs systematically. Chromosomes in GA represent possible watering schedules, with each gene encoding parameters related to watering frequency and light hours. The algorithm starts by generating a population of diverse watering schedules. A fitness function is used to predict targeted treatment programs that improve health outcomes while optimizing water use. Selection and crossover methods are employed to pass higher fitness genes to the next generation and create new solutions. Random changes through a mutation process help prevent convergence to suboptimal solutions. Genetic algorithms run for a specified number of generations until an optimal result, or termination, is reached for the irrigation system's stability or efficiency.

4.4 *Integration with irrigation system*

The integration with genetic algorithms provides an innovative approach in agricultural irrigation system. It optimizes the irrigation schedules through analyzing historical and real-time data. This helps in improving the water usage efficiency. These optimization process helps the irrigation system to adapt with the dynamic environmental conditions. This involves various fluctuations and varying weather patterns. The communication between the genetic algorithm controller and the distributed sensors is implemented using the WSN. They provide a control over the irrigation system.

Table 2. Sample data.

Field ID	Crop type	Genetic Algorithm Parameters	Irrigation Schedule (hours)
01	Wheat	Population Size: 50	Monday: 2, Wednesday: 1
02	Corn	Crossover Rate: 0.8	Tuesday: 3, Thursday: 2
03	Rice	Mutation Rate: 0.05	Friday: 1, Saturday: 2
04	Tomato	Generations: 100	Sunday: 1, Wednesday: 1
05	Potato	Selection Pressure: 0.2	Monday: 1, Thursday: 2

Table 2 represents the sample data after the integration of the genetic algorithm with the irrigation system. This helps in scheduling the irrigation based on the classification of crops and their requirements.

4.5 *Communication protocols*

The Wireless Sensor Network (WSN) protocol is a major communication protocol in the proposed irrigation system. Then routing of data packets in WSN is done using network layer protocol. Routing protocols which includes the Ad-hoc On-Demand Distance Vector (AODV) or Dynamic Source Routing (DSR) are used for the predicting whether the data reaches its end or destination point. For effective transmission of information, the Message Queuing Telemetry Transport (MQTT) protocol is used. The Low-Energy Adaptive Clustering Hierarchy (LEACH) are used for the conservation of energy in the sensor nodes in WSN networks.

4.6 *Testing and deployment*

The testing phase for the WSN-controlled irrigation system starts with unit tests to analyze individual components. This helps gather useful information on neighboring devices for data transfer. The final step is the implementation process in designated agricultural fields. Performance analysis as shown in Figure 1 shows the proposed system outperforms existing systems in irrigation.

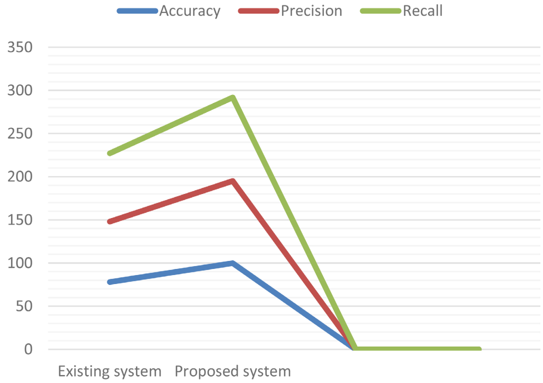

Figure 1. Comparative analysis.

5 EXPERIMENTAL RESULT AND DISCUSSION

The proposed system is implemented using Matlab Simulink. Figure 2 shows the result of soil temperature for analyzing the heat and pressure in the soil. Figure 3 shows the detection of soil moisture which helps to determine the amount of water necessary for plant growth.

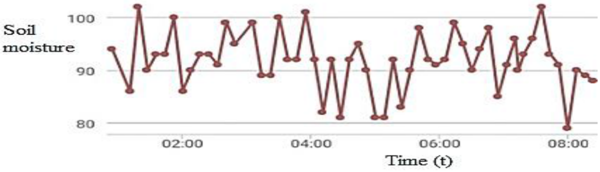

Figure 2. Soil temperature (demonstrates the soil temperature for analyzing the heat and pressure in the soil).

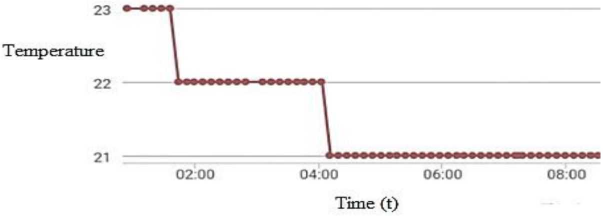

Figure 3. Detection of soil moisture (demonstrates the detection of soil moisture which helps to determine the amount of water necessary for plant growth.).

6 CONCLUSION

The introduction of wireless sensor networks and automation in irrigation systems is revolutionizing agriculture by improving sustainability and reliability. These innovative solutions address limitations of traditional methods, enhance yields, and enable real-time monitoring and automated decision-making for optimal crop moisture levels. Automation reduces manual labor, costs, and environmental impact while promoting sustainable agricultural practices and ecosystems.

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Exploring advanced learning capabilities in an Internet of Things (IoT) based smart plant irrigation system

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ABSTRACT: As the global population grows, and environmental safety is ever-increasing focus, precision farming plays a critical role in this initiative by increasing agricultural productivity. This study also develops and applies intelligent-machine learning models in the context of an IoT framework via an automatic plant-watering system. The other is in the controlled-environment greenhouses with real-time environmental sensors monitoring the crop conditions and then processed by models such as SVM, RF, CNN, ANN etc. Writer Bio Co-author Ratna Reddy said: “These models estimate agricultural yield and regulate irrigation, revolutionising agriculture. Best for smart agriculture applications, CNN has 98.55% accuracy, same as with ANN and SVM, where also scored high accuracy rates of 88–93%, and RF 90.43% accurate. This method is a step towards promoting data-driven agriculture and sustainable agricultural practices, which will improve the health of a crop and food security.

Keywords: Precision agriculture, smart irrigation, IoT, machine learning, environmental sensors, crop cultivation, CNN, ANN, SVM, RF, crop yield

1 INTRODUCTION

With the help of the Internet of things (IoT), the agriculture field has transformed drastically. Precision water delivery based on plant requirements by smart irrigation systems have improved productivity, resource efficiency and sustainable farming. By using the new technology of artificial intelligence (AI) and machine learning, agriculture today can take

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massive data sets from IoT sensors and determine the proper irrigation schedule and make other intelligent decisions. This AI system is capable of predicting future water needs by monitoring the historical data and environmental data also preventing water waste. Challenges related to data reliability, energy consumption, and user adoption remain that require further research in order to effectively leverage advanced learning in agriculture.

2 METHODOLOGY

The article specifies the methodology for developing and researching an IoT-based smart plant irrigation system designed to combine different sensors that are surveiling significant environmental conditions, which determine crop growth. The Figure 1 illustrates that the proposed System Architecture waters the plant based on the sensor data received from Soil moisture, Pressure, temperature and Humidity sensor. This entails deciding on hardware incorporating them into your existing farming system, as well as which sensors to put where in the field. By detecting air temperature, pressure, humidity, and soil moisture, these sensors provide data in real time which enables accurate irrigation control and maximum plant growth. ‘The main objective of the system is efficient data collection and communication.’ The CPU has a transistor, an Arduino or Raspberry Pi, sensors using Wi-Fi and Bluetooth. This data is then recorded and then sent to a local database for the central microcontroller todo its analysis and processing. It monitors real-time environmental data against pre-set limits, e.g. irrigating when the soil moisture falls below X,urrencriteria. Complex algorithms more accurately simulate irrigation by taking into account past weather, growth phases and other factors. The microcontroller includes these algorithms to guarantee the correct amount of moisture for the plants and reduce water consumption by turning off the pumps when conditions are acceptable. It allows for the irrigation process to be executed smoothly and conveniently via remote monitoring and control.

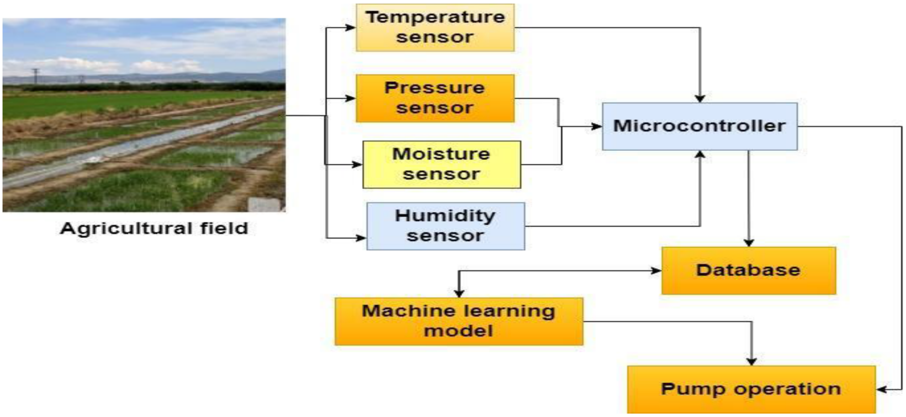

Figure 1. Architecture of the proposed system.

3 VARIOUS SENSOR USED IN THIS RESEARCH

The Internet of Things (IoT) relies on various sensors to provide accurate and efficient data for decision-making in plant irrigation systems. Temperature sensors are crucial in monitoring outside air temperature, which impacts plant growth. Barometer sensors predict weather patterns by monitoring barometric pressure, helping adjust watering schedules to avoid overwatering. Hygrometers measure humidity levels, ensuring proper watering and preventing moisture-related plant diseases. Soil moisture sensors, utilizing TDR principles, adjust water usage based on real-time data, increasing irrigation system stability and efficiency. Customizable sensors help conserve resources in water-scarce areas. These sensors work with microcontrollers and data acquisition systems, providing critical information for effective irrigation management. Overall, the adaptability and accuracy of these sensors play a vital role in optimizing plant irrigation systems and promoting sustainable agriculture practices.

4 NEED FOR MACHINE LEARNING

Modern irrigation systems, which are vital for crops such as rice, now consist of prediction algorithms that take into account temperature, pressure, humidity, etc., and create the optimal schedules for watering. By stopping your system from over-watering, problems, such as soil erosion, root rot and reduced water efficiency leading to unhealthy plants, are avoided. This approach is highly effective in water deprived areas with maximum plant growth, and minimum resource utilization.

5 VARIOUS MACHINE LEARNING MODEL USED IN THIS RESEARCH

Modern agricultural irrigation systems, which utilize a wide variety of environmental sensors to generate and analyze data that machine learning algorithms train on, are able to optimize water utilization imbibing crop productivity while minimizing the loss of resources. The model help determine when and how much water to provide for crops. We experiment with multiple important machine learning models in this research such as Artifiacial Neural Network (ANN), Convolutional Neural Networks (CNN), Support Vector Machines (SVM) and Random Forests (RF). As for simply watering your plants intelligently, each one of these would be good options depending on what you wished to use it with and what its other capabilities were.

5.1 *Artificial neural networks (ANN)*

Machine learning uses neural networks extensively, which is a biologically inspired network that resembles how the human brain works. Artificial neural networks (ANNs), are conformed by layers of artificial neurons assembled with the purpose to process data, detecting patterns and to elaborate complex characteristics Not Supported Exception. Flat Appearance. Firstly, artificial neural networks (ANNs) are highly flexible and can be easily applied to various applications such as speech recognition, text/picture analysis etc., and with this situation – irrigation system prediction modeling. Artificial Neural Networks (ANNs) and other machine learning models based on sensor data, temperature, pressure, humidity and previously measured soil moisture levels can be used to predict the future values of Soil Moisture in smart irrigation. “Our method is that the networks learn the correlations of various environmental conditions with how close or far away we are from achieving a given soil moisture target, which allows them to predict how quickly they’ll get there,” he said. And ANNs are also able to capture non-linear interactions, and much like the cubs brain they can recalibrate over time if so desired.

5.2 *Convolutional neural networks, or CNNs*

One type of artificial neural network, are used in analyzing visual inputs. For example, a CNN can take an image as input and identify objects or animals it depicts. Critical for jobs looking at agricultural images to try and identify but maybe not the best option re: predicting soil moisture. For example, CNNs could inspect the images of plants sent in by cameras inside an irrigation system that monitors crop conditions. Disease, stress or pests are recognized by these networks via visual signals. Early detection and treatment of plant problems by CNNs could increase the health and output of crops as well. That is, CNNs can be used to estimate the moisture content of soil from images with picture or satellite representation in order to investigate how site specific changes are reflected by moisture content.

5.3 *Support vector machines, Or SVMs*

Support Vector Machines (SVM) is a subset of supervised machine learning models which is widely used for regression and classification purposes. SVMs try to find the best (maximum margin) hyperplane that separates data points of different clasess It is possible to predict the essential factors such as possibility of rain or upcoming draught in case of smart irrigation with the help of SVMs. For example, by using historical meteorological data with temperature, pressure and humidity etc., SVMs can help in finding and predicting a weather which is suitable or unsuitable for irrigation. In addition, if a drought is expected or it's going to rain, the system will adjust its schedule accordingly. This measure even provides a call to proactive management and conservation of resources.

5.4 *Random forests (RF)*

A Random Forest (RF) is an ensemble learning technique that combines multiple decision trees to make predictions, and then the majority vote and average determines the results with a random subset of features and data. Data-centric functions also the where RF-based irrigation systems shine, by identifying and focusing on the environmental variables that affect soil moisture most in a field. We were able to do a great job with support vector machines, but they do not tend to work well with noisy data or are prone to overfitting, and they generally fail in real-world agricultural applications in heterogeneous data. Combining the two above-mentioned models – ANN for soil moisture prediction and SVM for weather forecasting – into hybrid models results in high performance due to large number of parameters functioning together. The methods have had technical promise, but face challenges of requiring high-quality, tagged training data, a manual effort often entailing high cost/time. Given that agricultural decisions are made by human experts, the interpretability of the results is very important; they need to understand the model predictions and confirm them. Function within fluctuating conditions, including different growing seasons, crop types, and weather patterns. Their use in real-world operations means that regular updates and retraining must take place. Design Prettiness Problem-solving Useless One hit wonder Models should deliver against a whole set of problems.

6 RESULT AND DISCUSSION

One of the key point to create rice is by controlling and monitoring soil dampness, temperature, pressure, moist conditions in this way essential for development of a particular harvest. Before that, I have trained machine learning models on the real-time data from sensors and use them to predict and control smart irrigation systems Use such models to predict irrigation requirements and crop output, efficiently use resources and enhance the overall health of crops. Lastly, the machine learning models' effectiveness is assessed as an irrigation management and crop forecasting tool. As shown in Figure 2, Convolutional Neural Networks (CNN) have the highest accuracy at 98.55%. Additionally, ANN, SVM and RF models are trustful to give the predictions in irrigation system as well. CNN outperformed other models because of its capability to identify intricate patterns in data, so it is the most useful model for plant irrigation systems (Figure 3). To sum up, machine learning models are vital in boosting agricultural production and smart irrigation by allowing better water management.

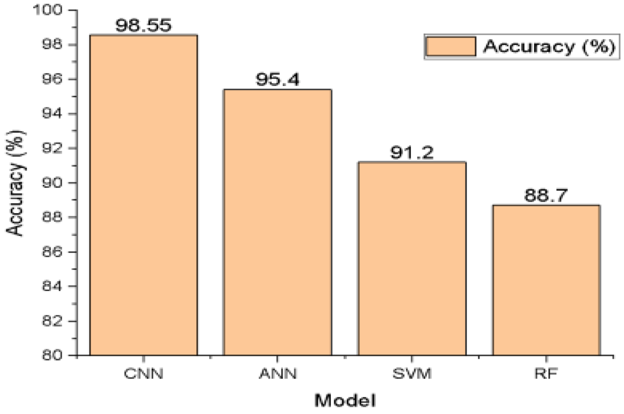

Figure 2. Accuracy of model.

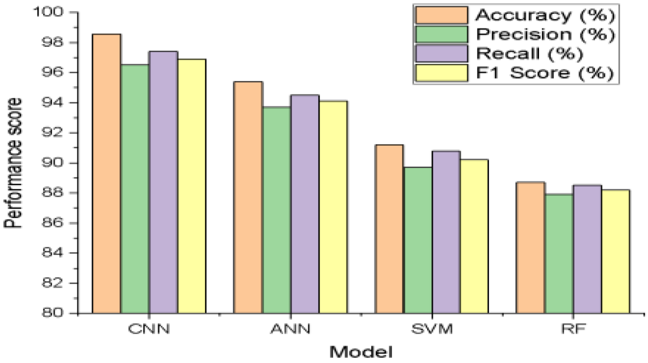

Figure 3. Performance score of each machine learning model.

7 CONCLUSION

In conclusion, this research demonstrates how data-driven precision agriculture and smart plant breeding technologies could revolutionize the agricultural sector. Important insights on crop decisions: these can be derived from various Sensors and machine learning model like irrigation management. “The prediction algorithm, which can be obtained using a large dataset, has been successful in achieving high accuracy rates for predicting crop yield as well as the conditions of irrigation motors.” Performance of CNN and other models such as Random Forest (RF), Artificial Neural Network (ANN) and Support Vector Machine (SVM) is given in the study itself this research further highlights the use of precision, recall and F1 index for achieve a compromise between accuracy and recall to reach maximum crop health as well as yield in sustainable agriculture. This work paves the way for future technologies in precision agriculture that will improve food security, resource conservation and productivity of farming as we pursue success in our mission to grow more with less.

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Facial recognition attendance system: Embracing openCV for real-time monitoring

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ABSTRACT: A face recognition attendance system is a biometric technology that uses artificial intelligence to identify and verify people based on their facial characteristics. It's a fast, high-accuracy system that's used in various sectors, including finance, retail, government, and industry. Attendance systems have evolved significantly over the years, with the advent of technology providing innovative solutions to streamline the process. Facial recognition has emerged as a promising technology in this domain due to its accuracy, efficiency, and non-intrusiveness. The system operates by capturing facial images using a camera and employing Machine learning algorithms to detect, extract, and analyze facial features. Utilizing Machine Learning Algorithm, we develop Face encoding of the captured images and then compare it with encoding present in database of the stored images. The system's architecture encompasses both hardware and software components, including camera modules, processing units, and a centralized database. The proposed system has been evaluated through extensive testing and validation, demonstrating promising results in terms of accuracy, speed, and reliability. Furthermore, the system's adaptability and scalability make it suitable for various industries, including education, corporate environments, and public institutions.

Keywords: Face recognition, face detection, Face Encoding, Computer vision, Firebase Database and Recognition mechanisms

1 INTRODUCTION

Facial recognition technology has become a common biometric feature in laptops, cell phones, attendance tracking systems, and other devices in recent years. Many organizations employ facial recognition systems for surveillance, home security automation, security access, and criminal identification procedures because of recent technological breakthroughs. In essence, face recognition software compares an individual's geometric traits with their facial features. The conventional approach stores user images in a database, which is then used to compare collected photographs with user images. A variety of traits were retrieved and applied as facial features, including corners, edges, and texture descriptors. For categorization, these features were used with machine learning methods [1,3,4].

The system utilizes computer vision, a field of artificial intelligence, to automate the attendance process by recognizing and verifying individuals based on their facial features in real time [2,6]. The following are the main elements and features of the system:

- Face Detection: Using powerful algorithms to locate and recognize faces in photos or video feeds. The processing that comes after depends on this first step [7].

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- These characteristics are converted into mathematical representations for identification, a process called “encoding of an image,” which helps with picture comparison [8].
- Real-Time Processing: People may be instantly recognized and verified as they enter or interact with the system because the system runs in real-time. This guarantees quick recording of attendance without generating any hiccups or delays [9].

2 LITERATURE REVIEW

Businesses, academic institutions, and government organizations frequently use automated facial recognition systems to track employee attendance. It is faster, more effective, and totally eliminates the need for physical labor when compared to manual approaches [2], [8] and [9]. The primary goals of a computer vision-based real-time face attendance system are usually to enhance the effectiveness, precision, and ease of use of attendance management procedures. These are the main goals: to use facial recognition technology to automate the recording of attendance. This reduces errors and time spent on old approaches by doing away with the requirement for human attendance marking [14]. to deliver real-time attendance reports. People are identified in real time, thus the system can record their attendance status instantly and without delay [15]. to guarantee a high degree of personal identification accuracy. The system aims to minimize false positives or negatives, accurately associating individuals with their attendance records. To streamline attendance management for both administrators and attendees. By eliminating manual processes, the system saves time and effort, allowing staff to focus on other essential tasks [16]. To integrate seamlessly with existing attendance management systems or databases. Compatibility ensures smooth implementation without disrupting established workflows. To offer an intuitive and user-friendly interface for both administrators and users interacting with the system. This promotes ease of use and acceptance among users. This adaptability allows the system to be implemented across different environments. To adhere to ethical standards and legal requirements concerning data privacy, consent, and the responsible use of facial recognition technology.

3 DATA COLLECTION & PREPROCESSING

Data preprocessing aims to clean, normalize, and prepare the data to enhance its quality and make it suitable for further analysis or model training. It also involves storing pre-processed data in a database so that it can be used further. The data of an individual is collected in the form of Name (Name of the student), Major (in which subject user is doing Course), Standing (Grade of User), Starting Year (Starting year of the Course), Year (Course Duration). Last Attendance and Total Attendance is added by Code. All these variables are bound up in a folder named Roll Number of User and saved in the Firebase database. The image which is taken from the webcam is of high pixel range and it can be a hectic task for our computer to generate encoding of that image and to store that high pixel image in our database can also be a waste of storage. The image captured from the webcam has extra information, which is not necessary for the face recognition algorithm, so to remove that extra information we first convert the high-pixel image into 256 * 256 and pass the image using various filters for the optimization of the image so that the image used for encoding can have more information regarding facial features. When the image is read from Open CV, its default format is BGR and our model uses RGB format, so with the help of Open CV, we convert BGR into RGB. After that, the image is named after the Roll Number of the user.

4 METHODOLOGY

For storing data, the Firebase Database is used which updates information in real-time. This database can store user information in real-time and update it in real-time. The Firebase

Realtime Database is a cloud-hosted NoSQL database that stores data in JSON format. Clients can instantly sync data changes across one another in milliseconds thanks to its real-time synchronization function. Numerous platforms, including web, iOS, Android, and server environments, allow access to the database. It is perfect for collaborative or multi-user applications since changes made by one client are immediately mirrored on all linked devices. Additionally, Firebase has offline functionality, allowing programs to continue running even in the absence of an internet connection. The database automatically updates any pending modifications upon reconnecting. Strong security controls are provided by Firebase to regulate database access. To protect user privacy and security, developers can define rules based on user roles, authentication, and data architectures. It easily combines with additional Firebase services [3]. The workflow of the system is shown in Figure 1.

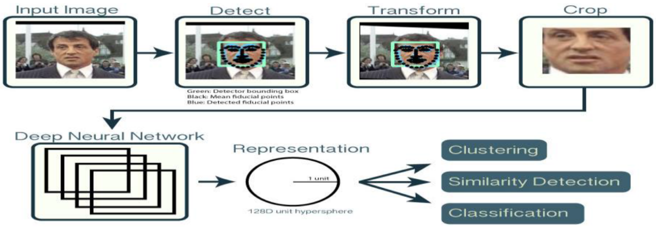


Figure 1. Workflow of system.

5 PROPOSED SYSTEM

5.1 *Data preprocessing*

The image captured by the webcam has a high pixel range, which means that encoding it and storing it in our database could be a laborious process for our computer and result in storage waste. The webcam image contains extra information that the face recognition algorithm does not need. To get rid of this extra information, we first convert the high-pixel image to 256 by 256 pixels and then optimize the image using different filters. This way, the image used for encoding can contain more information about facial features. Since our model uses the RGB format and the default BGR format for images read from OpenCV, we use OpenCV to help us convert BGR to RGB. The image is then given a name based on the user's roll number.

5.2 *Face detection*

Face detection is a computer vision technology used to identify and locate human faces within images or video frames. It's a foundational step in various applications, including facial recognition, security systems, photo editing software, and more. The technique of identifying a face in a picture is called detection. Facial recognition, made possible by computer vision, can recognize, and identify individual faces from a picture that contains the faces of one or more people [4]. A face detection example is shown in Figure 2.

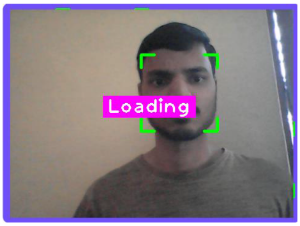


Figure 2. Face detection using face recognition.

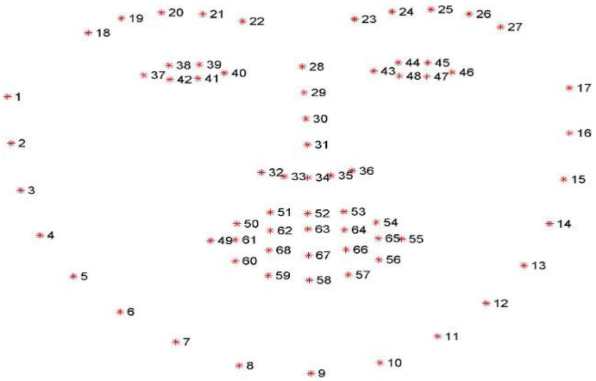


Figure 3. Dlib facial landmark detector.

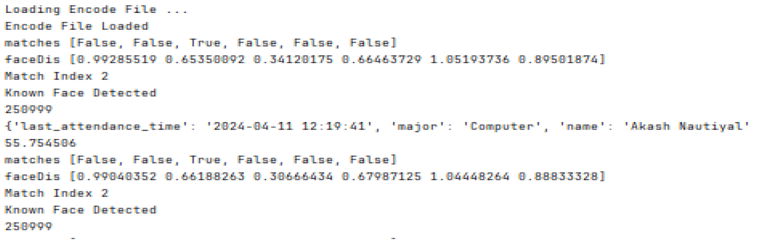
5.3 *Generate face encodings*

Generating face encodings involves converting facial images into numerical representations, enabling easy comparison and recognition of faces. One popular method for face encoding is using deep learning models, particularly face recognition models, to extract facial embeddings [5]. Dlib comes with a pre-trained landmark detector that detects 68 different landmark features as shown in Figure 3. A CNN that has been previously trained is used to generate the 128 encoding values. Due to its prior training on millions of training photos, the model can produce trustworthy encodings for faces it has never seen before. Images of the same individual ought to yield around the same 128-valued encoded vector. An extremely basic interface for extracting the encodings from an image and the set of rectangles that depict the faces in the image is offered by the facial recognition library. Finding out which person the face belongs to is as easy as measuring the distance between the new facial image and those in the encodings and choosing the one with the lowest distance value. This is done once you have the 128-valued encoded vector and the person's name as the label [6]. Figure 4 is taken from the webcam.

Figure 4. Input image from the camera model.

5.4 *Compare encodings*

In this process, we generally compare both the encoding of the database images and the captured images, and the matched result is stored in a list. The last value in the list is then identified by ID and is shown in the desired Graphics. We can see the least value in the array, and that value is then converted into Boolean as minimum value gets true and rest gets false [7]. After we get the index value of matched index, we update attendance in Database with last attendance time as shown in Figure 5.

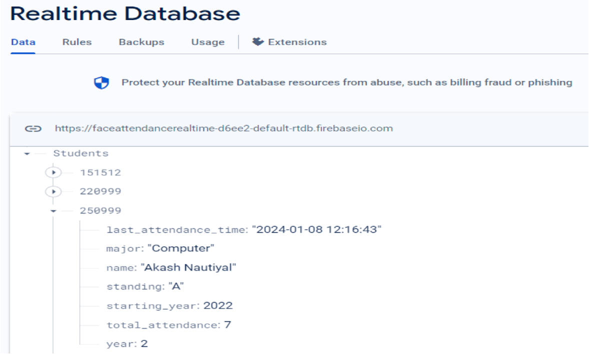


```
Loading Encode File ...
Encode File Loaded
matches [False, False, True, False, False, False]
faceDis [0.99285519 0.65350092 0.34120175 0.66463729 1.05193736 0.89501874]
Match Index 2
Known Face Detected
250999
{'last_attendance_time': '2024-04-11 12:19:41', 'major': 'Computer', 'name': 'Akash Nautiyal'
55.754506
matches [False, False, True, False, False, False]
faceDis [0.99040352 0.66188263 0.30666434 0.67987125 1.04448264 0.88833328]
Match Index 2
Known Face Detected
250999
```

Figure 5. Comparison of encoding.

5.5 *Update attendance in database*

After showing the desired image in the graphics, the attendance of the identified ID is then updated in the database in real-time (Figure 6). If the attendance is already marked it doesn't affect the database and the result “Already marked” is shown in the Output, otherwise, the attendance is increased by 1 and last attendance time is also updated.


Realtime Database
Data
Rules
Backups
Usage
Extensions
Protect your Realtime Database resources from abuse, such as billing fraud or phishing

https://faceattendancerealtime-d6ee2-default-rtdb.firebaseio.com

```
Students
    151512
    220999
    250999
        last_attendance_time: "2024-01-08 12:16:43"
        major: "Computer"
        name: "Akash Nautiyal"
        standing: "A"
        starting_year: 2022
        total_attendance: 7
        year: 2
```

Figure 6. User Information in the database.

6 RESULT

The image provided by the face encoder has its (128, 1) dimension encoding obtained using the face encoder. It is a 29-convolution-layer pre-trained ResNet network model. A dataset containing roughly 3 million faces is used to train the model. This system performs well in every aspect and performs with the same accuracy for every user whenever it is used for face attendance. It uses the Face Recognition library whose accuracy is 99.38% so because of that this system can recognize faces with the same accuracy and gives positive results every time. We are using Google Firebase as a database, and it is known for its smooth operation or updating data in real time so as the face is recognized by the model its attendance is marked in no time. We have tried this system with the information of 10 people, and it has marked attendance of them every time. The model's accuracy is 99.38%.

7 CONCLUSIONS

Applications for facial image processing include face recognition systems, and in recent years, their importance as a research topic has grown. University implementations of face recognition systems are possible. The goal of the Face Recognition Based Attendance

System is to decrease the errors that happen with the manual, traditional method of recording attendance. Automating and creating a system that benefits a company, like an institute, is the goal. This approach is workable, dependable, and sufficiently safe. The suggested method can identify several faces, and the system's performance yields respectable, decent outcomes.

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GPS using attendance tracking system

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ABSTRACT: GPS-based attendance marking system powered by AI allows for a fully automatic monitoring of attendance using GPs and geofencing technology through a smartphone app. It allows users to enter a set geographic area and their attendance is electronically tracked, the data is reported in real-time to a central server that makes the data available to coordinators and administrators for reporting and analytics. It is an attendance management system which ensures accurate attendance data, eliminates manual labor, is secure through bio-authentication, is simple to use, and allows for automated notifications. Find more information here: http://teckinfo.com/blog/ibp-iblocks-solution-teckinfo/ It is a trustworthy, economical, and adaptable solution for business offices and educational institutions, offering out dated mechanized by means of up-to-date automation to enable improved decision making.

Keywords: GPS-based attendance tracking, Geofencing technology, Real-time data synchronization, Automated notifications & Efficiency enhancement

1 INTRODUCTION

The system is referred to as a GPS Attendance Tracking System based on Python and Django to solve the limits with existing typical attendance techniques. All you have to do is provide the necessary details and it will handle the rest, because it is accurate, easy-to-use, and fully command-based, if you want to save time and keep manual records out. The system uses GPS technology in monitoring, and offers strong and scalable codebase for growth. This paper will describe the architecture, design, implementation, testing, the paper will document significant user interface problem spots that hinder practical usability.

2 LITERATURE SURVEY

AT PT.CIPTA ANUGRAH MUSI, DESIGN AN ATTENDANCE SYSTEM USING GLOBAL POSITIONING SYSTEM (GPS) TECHNOLOGY.

The purpose of this article is to describe the design, implementation, and assessment of a GPS-based attendance system at PT. Cipta Anugrah Musi. The major goal is to improve attendance tracking efficiency, accuracy, and provide real-time monitoring via GPS technology.

AUTOMATICATTENDANCE SYSTEM BASED ON FACE RECOGNITION USING MTCNN AND ARCFACE IN A SMART DESK IN A HYBRID CLASROOM

The purpose of this publication is to investigate and assess the deployment of a smart desk system equipped with facial recognition technology in a hybrid classroom setting utilizing MTCNN (Multi-task Cascaded Convolutional Networks) and ARCFACE to automate attendance. Through technology innovation, the major focus is on increasing attendance monitoring, engagement, and classroom management.

GPS-BASED SMART ATTENDANCE CONTROL SYSTEM WITH QR-CODE

The purpose of this publication is to look into the creation, implementation, and evaluation of a smart attendance control system that combines GPS technology with QR-code scanning. The major focus is on improving accuracy and assuring simplicity of use in diverse situations such as educational institutions or companies.

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MOBILE ATTENDANCE APPLICATIONIMPLEMENTATION USING GEO-FENCE TECHNIQUE

The purpose of this article is to investigate, build, and evaluate a mobile attendance application that uses the geo-fence approach for exact attendance monitoring. The major goal is to improve the efficiency, accuracy, and ease of tracking attendance within certain geographic borders.

3 PROBLEM STATEMENT

The conventional attendance system is based on manual techniques, such as paper-based sign-in sheets or card-swipe devices, which presents a number of issues. Create a complete problem description that addresses concerns such as time in efficiency, fraud vulnerability (e.g., buddy punching), a lack of real-time data, and the inconvenient nature of manual data entering. Propose a solution that takes advantage of contemporary technology to overcome these constraints and improve the overall efficiency and accuracy of the attendance tracking process.

4 EXISTING SYSTEM

Manual Sign-In Sheets: A traditional practice in which employees sign their names on a paper sheet as they arrive. Error-prone and time-consuming to handle. Employees punch in and out using a time clock, generally with a personal ID or badge. Although it provides greater accuracy than hand sheets, it is still prone to buddy punching.

Biometric Scanners: Identifies people using unique biological attributes such as fingerprints, retina scans, or palm prints. Increases security and decreases the possibility of false input.

Card Swipes: Employees swipe in and out using their ID cards or badges. Although it is a convenient and traceable approach, cards might be misplaced or exchanged.

Facial Recognition: Cutting-edge technology that recognizes people based on their facial traits. Non-intrusive and efficient, but may increase concerns about confidentiality.

5 PROPOSED SOLUTION

Some of the answers in developing the GPS attendance monitoring system are provided by our project.

Battery Consumption: Optimize the GPS tracking program to reduce battery consumption. This can involve altering location update frequencies and, where possible, using low-power modes.

Measures to Protect Privacy: Clearly describe to workers the purpose and usage of GPS data, providing openness and resolving any privacy concerns. To preserve personal information, use stringent data protection methods.

Geofencing: This technique is used to define precise geographical limits. Employees are recorded as present only when they are physically present at their assigned work location, eliminating fake check-ins from remote locations.

6 BENEFITS OF PROPOSED SYSTEM

With the model of GPS system for attendance, you can enjoy various benefits some of which are like: geofencing helps in making sure your employees are marking attendance only within the location being specified and also guard your employees against time theft, as the GPS monitoring keeps creating a track record which can be produced whenever required bringing in accountability and transparency in the system. Avoids fake checkins keeping the data more reliable and consumes less battery on smartphones due to the optimized application. Clear and transparent communication and data protection processes ensure privacy and compliance, which in turn leads to even more trust from employees.

The system helps in monitoring the attendance remotely, provides the real-time updates for quick decision-making and is also economical as it ensures the accuracy and security from malpractices which are followed in the conventional manner.

7 METHODOLOGIES

Front-end: This cloud-based GPS-enabled application uses HTML for tracking attendance at events, schools, and work locations. Administrators can view real-time attendance, generate reports, and configure geofencing, while users can check in/out, view maps, and manage attendance via a web interface.

Cascading Style Sheets: A GPS-integrated Attendance Tracking System uses CSS for a user-friendly interface with enhanced visual appeal and functionality. CSS ensures a unified design by customizing fonts, colors, spacing, and visual elements, and enables responsive design for various screen sizes and devices. Transitions and animations further improve user interaction, making attendance tracking more efficient and enjoyable.

JavaScript: Effective monitoring and management of attendance is facilitated by a GPS-integrated JavaScript-based attendance tracking system. The technology can monitor a person's exact location by accessing GPS data from devices using JavaScript. Because it confirms users' actual presence at designated sites, this technology guarantees accurate attendance records. Because of its adaptability, JavaScript can be easily integrated with web-based applications and accessed on a wide range of devices. All in all, this solution improves accountability and streamlines administrative procedures by utilizing GPS technology to improve attendance monitoring.

Bootstrap: The accuracy and efficiency of attendance management may be increased by using GPS in an attendance monitoring system. The system can precisely track workers' or students' locations as they clock in or out by incorporating GPS technology, guaranteeing their actual presence at the assigned spot. This aids in the prevention of attendance fraud and offers real-time attendance tracking, allowing prompt response in the event that disparities occur. Furthermore, GPS-enabled attendance monitoring provides flexibility by making it simple for field workers or remote workers to record their attendance from any location with an internet connection. All things considered, using GPS in attendance tracking systems improves dependability, accountability, and openness in the process of tracking attendance.

Back-end: Python/Django
An all-encompassing solution for effectively managing attendance records with location tracking features is provided by a GPS-integrated attendance monitoring system built on the Python/Django programming language. With the use of this technology, businesses may precisely track employee or student attendance, maintaining responsibility and improving overall productivity. With the help of Django's adaptable framework and Python's powerful capabilities, developers may design a platform that is both scalable and adjustable to meet the unique requirements of the company. By including GPS technology, administrators may confirm an individual's position as they clock in or out, adding an added degree of precision. Workers and students can track their attendance using mobile devices or gear that has been specially designed using GPS technology. The system logs the user's current location, timestamp, and other pertinent information once they log in. This information is kept safe in a centralized database and offers up-to-date insights regarding trends and patterns in attendance. Administrators may check attendance statistics, monitor attendance patterns, and spot any abnormalitiesor inconsistencies by logging onto an intuitive dashboard. They can confirm the accuracy of attendance records and guarantee that attendance regulations are being followed thanks to the GPS data. In addition, the system has the ability to automatically send out warnings or notifications in the event of unannounced departures, late arrivals, or absences according to preset rules. This proactive strategy facilitates the reduction of concerns linked to attendance and the simplification of administrative responsibilities. All things considered, an Attendance Tracking System based onPython/Djangowith GPS connectivity provides

businesses with a strong tool to improve worker or student productivity, increase responsibility and expedite attendance management procedures.

Tools: Visual Studio Code
Visual Studio Code (VS Code) is a versatile IDE ideal for developing, testing, and implementing GPS-based attendance monitoring systems. It supports multiple programming languages and facilitates easy integration of GPS libraries. With built-in Git for version control, robust debugging tools, and seamless deployment capabilities, VS Code ensures efficient code development, troubleshooting, and collaboration. This makes it a powerful tool for creating reliable and scalable attendance management solutions.

Database: My SQL
SQL is used to fetch attendance data, update & analyze attendance data in GPS based Attendance Monitoring System. SQL SELECT queries return attendance records, and COUNT(), SUM(), AVG() and other aggregation functions compute attendance statistics. Employee information (attendance log, analysis of employee behavior): using the INSERT, UPDATE, DELETE statement to manage employee data.

8 WORK FLOW

8.1 *User check-in/check-out*

When users go to work, they launch the application. Their geographical locations are automatically recorded by the app, which then encourages users to check in. When users confirm their check-in, the system logs their location and time.

8.2 *GPS tracking initialization*

The program starts GPS monitoring and asks users for authorization location rights.

8.3 *User check-in/check-out*

When users go to work, they launch the application. Their geographical locations are automatically recorded by the app, which then encourages users to check in. When users confirm their check-in, the system logs their location and time.

8.4 *Attendance monitoring*

The application updates the user's GPS coordinates on occasions during the workday. Using a dashboard or reporting interface, admins can maintain an eye on real-time attendance statistics. Similar to check-in, users may check out when they leave the workplace.

8.5 *GPS data processing*

In order to guarantee accuracy and reliability, the system processes GPS data constantly. In order to eliminate inaccurate or inconsistent GPS readings, algorithms may be used.

8.6 *Attendance records storage*

In order to ensure accuracy and dependability, the system processes GPS data continually. In order to eliminate not accurate or inconsistent GPS readings, algorithms may be applied.

8.7 *Reporting and analysis*

Administrators have the ability to create reports that analyze attendance movements, such as early departures, late arrivals, and absences from work.

8.8 *Data privacy and security*

The system protects sensitive data, like user identities and location information, by ensuring compliance with privacy regulations. Data integrity and confidentiality can be maintained by the implementation of access control and encryption techniques.

8.9 *System maintenance and updates*

For maintaining system security and confidence, regular upkeep measures will be carried out, such as database backups and software updates. Administrator and user feedback is analyzed to figure out which needs to be fixed as well as which features must be added. Figure 1 shows the flow diagram of the proposed system.

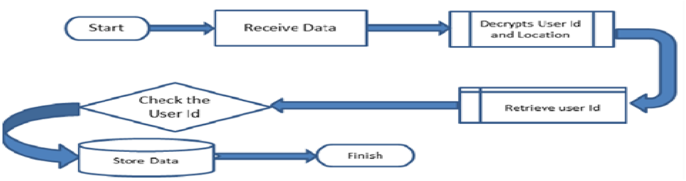


Figure 1. Flow diagram.

9 EMPLOYEE LOGIN METHODOLOGY

When a person accesses the website using the let's get started button, the home page is displayed first. When the Let's Get Started button is pressed, the website is routed to the login page, where the login option is displayed. After logging in, the page is forwarded to the console, which contains sections such as message, enrolled assignments, completed and task, total grade, and the calendar.

9.1 *Authentication*

Only authorized users would be able to access it thanks to authentication and permission. User identification via login credentials would be required, as would access control based on user roles and permissions. There are two sorts of user roles here: employee/user and administrator/instructor. Figure 2 shows the login page.

Figure 2. Login page.

9.2 *Create attendance*

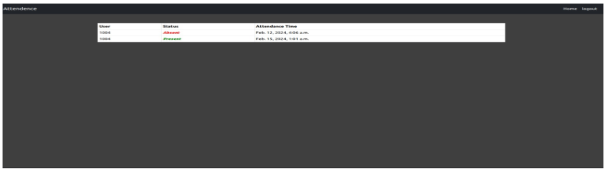
If we click on the generate attendance button, the location is accessed and the attendance is marked if we are in the proper place; otherwise, the attendance is marked (Figure 3).

Attendance recorded successfully!

Figure 3. Create attendance.

9.3 *View attention*

We may view our attendance and when we recorded the attendance and time by clicking on the view attendance button (Figure 4).



User	Status	Attendance Time
1004	Absent	Feb. 12, 2024, 4:06 a.m.
1004	Present	Feb. 15, 2024, 1:01 a.m.

Figure 4. View attendance.

10 CONCLUSION

A GPS attendance tracking system may provide various advantages to businesses, including a more effective and precise method of monitoring employee attendance. Consider summarizing crucial facts and ideas when you end your investigation of this system. Finally, using a GPS attendance monitoring system is a solid answer for firms looking to streamline their attendance management operations. The system's use of GPS technology enables precise and real-time tracking of employee whereabouts, decreasing the possibility of inaccuracies associated with traditional attendance systems. This technology not only improves overall attendance monitoring efficiency, but it also fosters openness and responsibility within the workforce.

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Health guardian: Employing machine learning for early detection and management of chronic diseases to improve healthcare and patient outcomes

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ABSTRACT: In the face of intricate disease mechanisms and symptoms globally, there is a pressing need for advanced detection methods and treatment strategies. Today's lifestyle and habits contribute significantly to various health issues, underscoring the importance of early identification and prediction to mitigate their severity. Unfortunately, clinicians often struggle with precise diagnosis in the early stages of diseases. To address this challenge, machine learning algorithms offer promising predictive capabilities, assisting healthcare professionals, researchers, and patients alike. This paper proposes a novel approach to forecast chronic illnesses by integrating contextual factors like symptoms and lifestyle choices. It advocates for an interactive interface that engages users with pertinent questions, leveraging machine learning algorithms for prediction. By leveraging diverse datasets, the framework trains and validates models, ensuring accurate disease prognosis. Employing Convolutional Neural Networks for feature extraction, alongside classification models like Support Vector Machine, Naive Bayes, and Random Forest in R programming, ensures robust predictions. The resulting disease prediction system amalgamates these models, promising high accuracy and reliability, facilitating early intervention and enhanced patient outcomes. A user-friendly interface enhances the overall experience, streamlining the input of patient data. The paper provides a comparative analysis of outcomes generated by these algorithms, highlighting their efficacy.

Keywords: Disease prediction, Machine learning algorithms, Chronic illnesses, Lifestyle factors

1 INTRODUCTION

Chronic diseases represent a significant burden on globe, affecting people worldwide and posing serious challenges to health systems. Even with advancements in medical science and technology, the incidence of chronic diseases continues to increase due to aging populations, sedentary lifestyles, poor diets, environmental factors, and socioeconomic disparities. Addressing this rapidly evolving health crisis requires innovative approaches that not only enable early detection and intervention but also delve deeper into the complex interactions between lifestyle choices and disease development [16]. In recent years, the emergence of machine learning (ML) has revolutionized many different fields, including health. By analysing multifaceted data streams and uncovering subtle relationships, machine learning can increase diagnostic precision, refine treatment methods, and enhance patient results. The study aims to explore the intersection between machine learning and chronic disease detection. By using the existing literature, developing a methodological framework, for extracting features using Support Vector Machine, [12] Naive Bayes, and Random Forest as classification models in R programming to create accurate disease prediction ensemble model.

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2 LITERATURE REVIEW

The study focuses on the testing and identification of medical conditions which are normally difficult to diagnose, such as tumour in initial phase and other genetic illnesses. It discusses the several use cases and opportunities for ML in medical diagnosis, emphasizing its potential to accelerate the diagnosis of numerous diseases, including cancer [1]. The overall idea of the paper is to identify the chronic diseases with the help of ML models. It also highlights that (SVM), logistic regression (LR), are commonly used algorithms, and to identify and classify diseases these models are highly appropriate [2]. In this study ML is used for automatic analysis of diagnostic features from clinical imaging and molecular tests, as well as its ability to assist physicians in diagnosis and treatment through the integration of smart watches and smart home devices to collect and analyse patient health data for early disease detection and ongoing monitoring [3]. This study compares different algorithms such as Naive Bayes, KNN, SVM, and logistic regression in diagnosing diseases like Covid-19, skin cancer, and thyroid disease. The findings show the effectiveness of these algorithms in achieving high accuracy rates in disease detection [4]. It highlights the evolution of disease prediction models from logistic regression to deep learning, emphasizing the continuous improvement in accuracy and performance. It introduces various deep learning frameworks for chronic diseases such as Neural Diseases, Heart problems, Eyesight problems, Diabetes, and Cancer, and corresponding deep learning prediction methods [5]. A novel method that explores the use cases of ML and AI to identify and understand autoimmune conditions. It covers various autoimmune diseases and discusses the common methods, data types, applications, challenges, and future possibilities in this interdisciplinary field [6]. The research highlights the importance of connecting systems, data, and people in managing chronic diseases effectively. It discusses emerging techniques in health information systems analytics research. The paper covers theoretical approaches, methodological approaches, and data sources to address problems like readmissions, self-monitoring, health costs, and patient-provider relationships in chronic conditions like asthma, diabetes, COPD, and depression [7]. Study addresses the importance of fairness and transparency in machine learning model to build trust among patients and healthcare professionals. Paper highlights the importance of fairness and explainability in ML models to ensure equal outcomes and build trust in healthcare [8]. The study's results focus on importance of adopting a healthy lifestyle, including factors like maintaining a healthy weight, not smoking, engaging in physical activity, and moderate alcohol consumption, in promoting disease free life years. These findings provide valuable information about benefits of healthy lifestyle choices in preventing major chronic diseases and promoting overall healthy life [9]. It examined the connection of life free of chronic diseases when a person adopt a healthy lifestyle. Study found that adopting low-risk lifestyle factors results in increased life expectancy free of diabetes, cardiovascular diseases, and cancer. It promotes a healthy lifestyle to reduce the risk of chronic diseases and live disease-free life, thereby reducing healthcare burdens [10]. Paper discusses the impact of lifestyle choices on chronic diseases and non-communicable diseases. Unhealthy habits like high blood pressure, tobacco use, lack of physical activity, diabetes, and obesity are major risk factors for diseases. It focuses on need for nutritional counselling, exercise, de-addiction programs, regular checkups, and stress management to combat these diseases [11].

3 PROPOSED WORKS

Combining multiple machine learning algorithms, such as Support Vector Machines (SVM), Naive Bayes, and Random Forest, can often outperform a single algorithm. Here are some of the advantages of this ensemble approach. Reduced bias: If one algorithm has a high bias (underfitting) on certain types of data, another algorithm may outperform it. By combining different models one can average out bias and balance the predictions. If one algorithm has a high variance (overfitting), combining it with other models with different generalisation patterns can help reduce overall variance. Ensemble methods, such as Random Forest, are especially effective because they build multiple trees and average their predictions. Improved robustness: Combining models can strengthen the overall system against noise in the data. Noise may affect one model but have a smaller impact when combined with others. Ensemble methods frequently outperform individual models in terms of generalisation performance on previously unseen data [13].

3.1 *Step-wise approach to run the framework*

- Interaction of user with our interface.
- Activation of background tasks like running few models on given input.
- Comparing results of different models and considering the most relevant result.

3.2 *Data set acquisition and diversity*

All the datasets for our framework are acquired from internet. It contains 24 datasets. In these datasets, there were variety of diseases with their different symptoms. Model is trained using these datasets. Took 20 datasets for training and 4 for testing. The data collected can be separated majorly into two categories diseases and symptoms. Further, symptoms are of different types so the weightage for each symptom is equal. This is done to bring fairness in our model [14].

4 METHODOLOGY AND MODEL SPECIFICATIONS

This methodology involves initially splitting the dataset into a training set and a testing set. The training set is used to train the models, while the testing set evaluates their performance. Following this, the data undergoes preprocessing, addressing inconsistencies, missing values, and potentially normalizing features. Feature engineering is then applied to create new features or enhance existing ones, aiming to improve the models' predictive capabilities. Next, three machine learning models—Support Vector Machine (SVM), Naïve Bayes, and Random Forest—are individually trained. SVM aims to find the optimal hyperplane to separate data, Naïve Bayes utilizes probabilistic reasoning based on feature independence, and Random Forest builds multiple decision trees and aggregates their predictions. After training, each model predicts outcomes on the testing data independently. Subsequently, we combine these predictions using two methods: Majority Voting and Weighted Voting. Majority Voting selects the most predicted outcome across all models, while Weighted Voting assigns different weights to each model's prediction. Finally, we evaluate the combined predictions using various metrics such as accuracy, precision, recall, and F1-score. Figure 1. shows the flow chart of our working Ensemble Model.

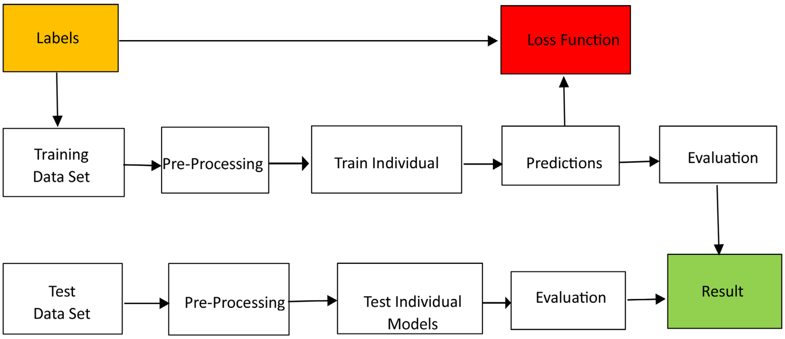

Figure 1. Flow chart of our working ensemble model.

- Split Data: Data is split into Training Data and Testing Data.
- Data Preprocessing: Data Cleaning, Data Transformation and Feature Engineering will be done.
- Train Individual Models: Train SVM, Naïve Bayes and Random Forest individually.
- Make Predictions: Predict using SVM, Naïve Bayes and Random Forest Individually.
- Combine Predictions: Combine and predict on basis of Majority Voting and Weighted Voting.
- Evaluation: Evaluate performance

5 EMPIRICAL RESULTS

Table 1 shows the scores of Accuracy, Precision and Recall of different ML Models.

Table 1. The scores of accuracy, precision and recall of different ML models.

Models	Accuracy (%)	Precision (%)	Recall (%)
Naive Bayes	78	75	72
Random Forest	82	80	78
SVM	85	82	75
Ensemble Model	93	89	84

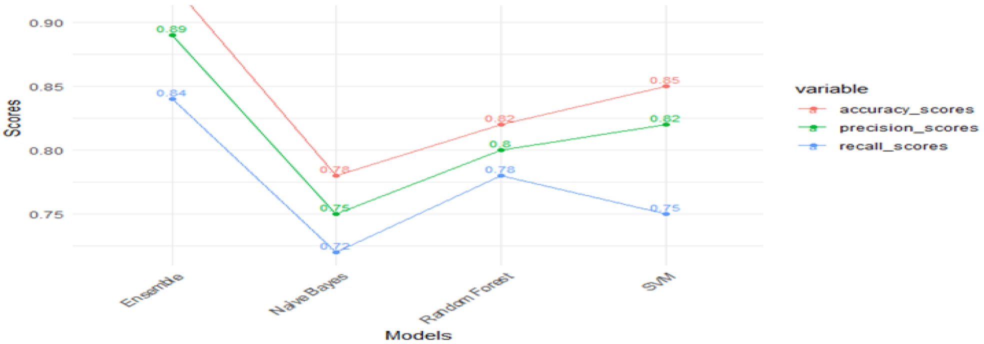

Figure 2. Comparison of accuracy, precision and recall scores.

Our research demonstrates promising outcomes in disease detection, accompanied by an accuracy score, depicted in Figure 2. Initially, users select a set of symptoms, upon which our machine learning algorithms operate to forecast a disease. While our ensemble model can predict multiple diseases for the same input, it ultimately presents the one with the highest confidence score. Our high degree of prediction accuracy has been attained by utilising a sophisticated combination of algorithms. Using combination of Support Vector Machine (SVM), Naive Bayes and Random Forest have significantly increased the accuracy of our model up to 93 percent. Although SVM initially had problems with long computation times and poor accuracy, the introduction of Naive Bayes and Random Forest classifiers offered alternatives. Every classifier has special advantages. Strong baseline SVM is well-known for its efficiency in class separation in high-dimensional spaces. Naive Bayes provides computational efficiency and simplicity by utilising conditional independence among features. With its ability to combine predictions from several decision trees, Random Forest is highly accurate and resistant to overfitting. Figure 3. shows the comparison of Accuracy Scores.

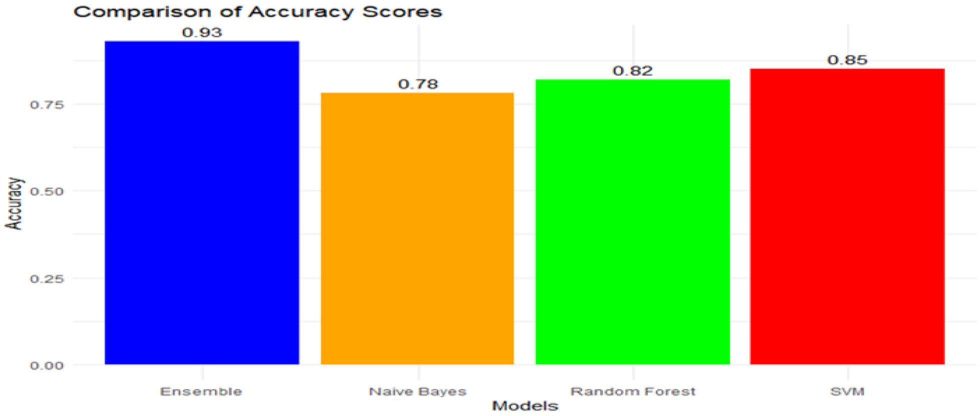

Figure 3. Comparison of accuracy scores.

After extensive testing, SVM, Naive Bayes, and Random Forest all demonstrate excellent accuracies of 85 percent, 82 percent, and 78 percent, respectively and by using them in ensemble model our accuracy increased significantly up to 93 percent as depicted in Figure 3. This increase in accuracy guarantees accurate and timely diagnosis of chronic diseases, improving patient outcomes. Furthermore, when paired with SVM, the integration of Random Forest and Naive Bayes classifiers lowers processing time and computational complexity. This method's value in medical diagnostics is highlighted by its increased efficiency without sacrificing accuracy. To sum up, the ensemble of SVM with Naive Bayes and Random Forest classifiers is a noteworthy progress in the identification of chronic diseases, providing enhanced precision and effectiveness. Prolonged investigation and refinement of these classifiers could lead to further progress in the provision of healthcare services.

6 CONCLUSIONS

The findings of a study that used machine learning algorithms to identify chronic diseases in humans are presented. Using information from people's medical records, the study's main goal was to assess how well various machine learning models could accurately identify chronic illnesses. The research highlights the accuracy of models to predict chronic illnesses, consequently assisting medical professionals to cure these diseases and customised treatment plans. Strong performance of specific machine learning models suggests that they could be helpful in real-world clinical settings for early disease detection and appropriate intervention. However, further research is required to address issues like unequal data distribution, heterogeneous data kinds, and guaranteeing generalizability across different demographic segments. It is recommended that future research focus on improving model designs, adding more data streams, and implementing prospective clinical validation trials to increase the applicability and reliability of these algorithms in actual healthcare environments.

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Herbal garden monitoring using IOT based system

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ABSTRACT: Herbal gardens, with their diverse range of medicinal and aromatic plants, play a vital role in healthcare, agriculture, and environmental conservation. Managing these gardens efficiently is crucial for preserving plant biodiversity and harnessing the therapeutic potential of herbs. The Internet of Things (IoT) offers a powerful solution for monitoring and maintaining herbal gardens effectively. In this paper, the data of different herbal plants from herbal garden is collected. The physical characteristics of plants like temperature, humidity, plant life is collected. The concept of monitoring herbal gardens using IoT to improve the overall growth and monitoring of plants is proposed in this article. Different sensors can be implemented in herbal plants and they can be monitored with the help of IoT devices. Creating a herbal garden with the integration of Internet of Things (IoT) technology can be a fascinating and productive endeavor. IoT can enhance the experience by providing real-time data, automation, and remote control.

Keywords: Herbal Garden, Internet of Things, Sensors, Plants

1 INTRODUCTION

For Biodiversity Conservation IoT can help to ensure the survival of a variety of plant species, some of which may be endangered or require specific environmental conditions by maintaining optimal growth conditions. In medicinal plant research IoT monitoring can provide researchers with precise data on plant growth, facilitating scientific studies for studying the therapeutic properties of medicinal plants. Monitoring soil moisture, temperature, and light levels with the help of IoT can help in optimizing resource allocation, reduce water consumption, and lower energy costs in herbal garden management [1]. IoT systems enable remote monitoring, allowing gardeners and researchers to access real-time data and make informed decisions from anywhere. An IoT system can be embedded with herbal garden to provide a number of applications. IoT-connected sensors can be used to monitor soil moisture levels. When the soil becomes too dry, the system can automatically activate a drip irrigation system or notify to water the plants through a mobile app. This helps ensure

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the herbs receive the right amount of water. IoT embedded station can be implemented in herbal garden to monitor weather conditions, to collect data on temperature, humidity, and sunlight [2,3]. This data can be used to adjust watering schedules, shading, and other factors to optimize plant growth. Incorporate smart lighting systems that adjust the intensity and duration of artificial light for herbs based on their specific needs. IoT can help to simulate natural light conditions, even in indoor gardens.

2 LITERATURE SURVEY

To maintain optimal temperature and humidity levels for herbs, IoT-controlled heaters, fans, or misters can be installed [4,5]. IoT-enabled sensors can be utilized to monitor nutrient levels in the soil. An alert message can be received when it's time to add fertilizers or nutrients to ensure healthy plant growth. IoT-enabled security cameras and motion sensors can be used to protect herbal garden from theft or pests. These devices can send alerts to user phone if any suspicious activity is detected. IoT-connected cameras or specialized sensors can be used to monitor the health of plants. These devices can detect signs of disease, pests, or nutrient deficiencies and provide recommendations for treatment. In larger herbal gardens, IoT-controlled robotic arms or harvesters can be implemented to autonomously pick ripe herbs. With the help of various IoT sensors, the data can be collected and analytics tools can be used to gain insights into the growth patterns and conditions that lead to the best herb yields [6,7]. This data-driven approach can help us to fine-tune the gardening practices. With the help of IoT, the status of garden from anywhere, alert messages and setting of different devices can be monitored through mobile app. By integrating IoT technology into herbal garden, an efficient, data-driven, and enjoyable gardening experience can be achieved while ensuring herbs thrive and produce bountiful yields [8,9].

Brahmi is a small, creeping herb known for its cognitive-enhancing properties. It is used in traditional Ayurvedic medicine to improve memory and concentration. Amla, also known as Indian gooseberry, is a potent source of Vitamin C. It is used in Ayurvedic preparations for its antioxidant and immune-boosting properties. Giloy, or Guduchi, is a climbing herb that is renowned for its immunomodulatory and anti-inflammatory properties. It's often used to boost the immune system. Ashwagandha is a well-known adaptogen in Ayurveda. It is used for its stress-reducing, energy-boosting, and rejuvenating effects. Neem is a versatile tree known for its antimicrobial and skin-healing properties. Various parts of the neem tree, such as leaves, bark, and seeds, are used for different purposes. Arjuna is a tree whose bark is used in Ayurveda for heart health. It is believed to strengthen the cardiovascular system and manage blood pressure. The seeds of the Rudraksha tree are used for making prayer beads and are believed to have spiritual and meditative benefits. Turmeric is a well-known spice with potent anti-inflammatory and antioxidant properties. It's widely used in cooking and traditional medicine. The bark of the Himalayan Yew tree is a source of the anti-cancer drug Taxol. However, it is important to note that the plant is endangered and should not be harvested without proper authorization. Bhumi Amla is used in Ayurvedic medicine for its hepatoprotective properties and is believed to support liver health. Several species of Arisaema are found in Uttarakhand and are used in traditional medicine for their analgesic and anti-inflammatory properties. Himalayan Blue Poppy is known for its medicinal properties and is used to make traditional remedies for various ailments [10–18].

3 MATERIALS AND METHODS

The different components with their application of an IoT-Based Herbal Garden Monitoring System are explained in this section. Soil Moisture Sensor is used monitor soil moisture levels and prevent over or under-watering. Temperature and Humidity Sensor is used for tracking environmental conditions. Light Sensor is used to measure light intensity and ensure optimal conditions for plant growth. Camera System is used for visual monitoring of plant health and any potential issues. The sensors are connected to an IoT platform or gateway using wireless protocols like Wi-Fi, LoRa, or Zigbee. Central Control System is used to process and analyze different inputs. It may be a local server or a cloud-based platform that provides real-time insights and visualization of garden conditions.

Uttarakhand, a state in northern India, is known for its rich biodiversity and diverse flora. It is home to a wide range of herbal plants that have been used for medicinal and therapeutic purposes for generations. Here are some herbal plants commonly found in Uttarakhand are shown in Table 1 with different physical properties and according to these parameters system could be adapted.

Table 1. Physical properties of different herbal plants.

S. No.	Plant Name	Availability	Temp.	Humidity	Soil	Light	Water
1	Bacopa monnieri [10]	wetlands and marshy areas	20°C (68°F) to 35°C (95°F)	70% or higher	rich, loamy or sandy soil	mild	moist
2	Emblica officinalis [11]	widely available in India	20°C (68°F) to 37°C (98°F)	moderate humidity	well-draining soil, moderately acidic to neutral	6–8 hours direct	Normal irrigation
3	Tinospora cordifolia [12,17]	widely available in India	20°C (68°F) to 30°C (86°F)	moderate to high humidity, higher humidity is preferable	well-draining, fertile soil sandy soil with a moderately acidic to neutral (pH around 6.5)	4–6 hours direct or indirect	regular watering, moist
4	Withania somnifera [13]	arid and semi-arid regions	20°C (68°F) to 30°C (86°F)	lower to moderate humidity	moderately alkaline to neutral soil (pH level of 7 to 8)	6–8 hours direct	drought-tolerant
5	Azadirachta indica [14]	versatile tree native to the Indian subcontinent	temperature remains consistently warm	moderate to high humidity levels	moderately alkaline to neutral soil (pH level 6.5 to 7.5)	6–8 hours direct	drought-tolerant, less frequent watering
6	Terminalia arjuna [18]	native to the Indian subcontinent	20°C (68°F) and 35°C (95°F)	moderate to high humidity	moderately acidic to neutral (pH 6.5–7.5).	6–8 hours direct	drought-tolerant
7	Elaeocarpus ganitrus [15]	native to the Himalayan region	25°C (77°F) and 35°C (95°F)	moderate to high humidity	moderately acidic to neutral (pH level 6.0–7.5)	6–8 hours direct	need regular watering
8	Curcuma longa [16]	widely available in India, tropical and subtropical areas	20°C (68°F) and 30°C (86°F)	high humidity	moderately acidic to neutral pH (6.0–7.5)	6–8 hours	moist

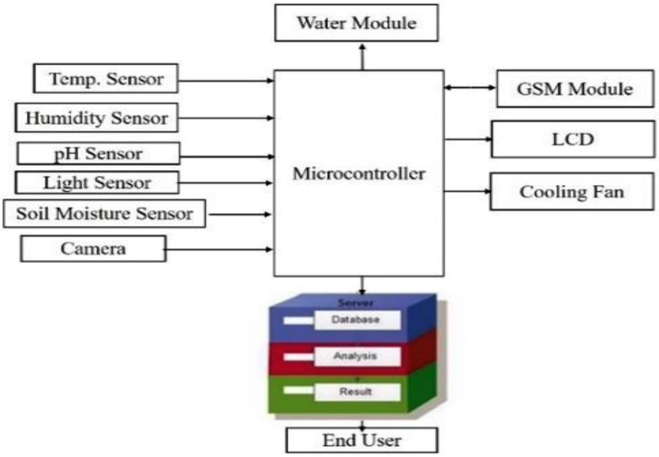

Figure 1. Block diagram of IOT enabled herbal garden.

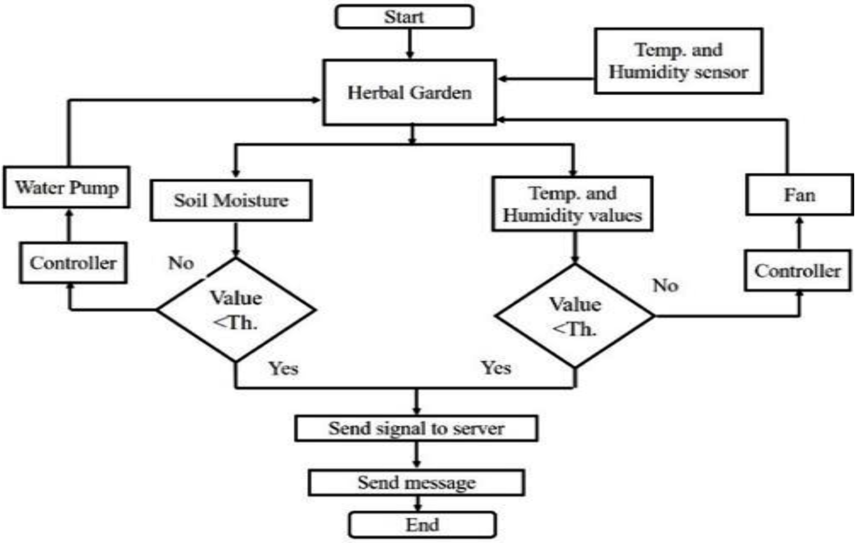

Figure 2. Flow diagram of the mechanism of herbal garden.

The block diagram of the planned model for the IOT-enabled herbal garden monitoring is shown in Figure 1. All the sensors are connected as the input and water controlling unit, cooling fan is connected as output. These information's are processed using controller. This processed information is further communicated to end user by using protocols. Figure 2 shows the flow diagram of the mechanism of herbal garden.

With the assistance of the controller, all sensor inputs are monitored and the controller's output data is utilized to monitor the condition of the herbal garden. The end user can use this information to monitor the health of herbal plants. comparators are used to compare the temp., humidity range, soil moisture of the herbal garden. if there are any requirements based on the controller's data, the water pump and cooling fan will work and control the environment of the herbal garden.

4 CONCLUSIONS

The initial setup cost of an IoT-based herbal garden monitoring system can be significant, including the purchase of sensors and IoT hardware. Regular maintenance of sensors and IoT infrastructure is necessary to ensure accurate data collection. The integration of IoT in herbal garden monitoring represents a promising advancement in agriculture, biodiversity conservation, and research. As technology continues to evolve, it can be anticipated further developments, including the incorporation of artificial intelligence for predictive analytics and the use of drones for aerial monitoring of larger herbal garden areas. The monitoring of herbal gardens using IoT offers numerous benefits, from efficient resource management to biodiversity conservation and scientific research. By leveraging the power of IoT, herbal gardens can thrive and contribute to healthcare, agriculture, and environmental sustainability while enhancing our understanding of the natural world.

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Industrial surveillance and monitoring system

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ABSTRACT: The Internet of Things (IoT) is rapidly expanding, transforming technology by integrating connected devices into various aspects of our lives. This project introduces an IoT-based monitoring and security system that uses multiple sensors and devices to monitor environmental conditions and enhance safety in real-time. It utilizes the ESP32 microcontroller for live streaming and integrates a PIR motion sensor for human movement detection. Sensors for temperature, humidity, and gases are included, along with a buzzer for audible alerts. The ESP32-CAM enables live video streaming for continuous monitoring, with data transmitted to the cloud via the Blynk platform for remote control and monitoring. Additionally, the project implements a fire detection system using ESP32 micro-controllers and flame sensors for prompt response to fire incidents in industrial settings. This project showcases the practical applications of IoT in enhancing productivity, safety, and environmental monitoring.

Keywords: Internet of Things (IoT), Monitoring and Security System, ESP32 Microcontroller, Environmental Monitoring & Fire Detection System

1 INTRODUCTION

Embedded systems have revolutionised technology in the last few years by offering specialised computing solutions for a wide range of applications. Embedded systems, in contrast to general-purpose computers, are designed to execute certain tasks in limited contexts under strict performance guidelines. They are essential to many industries, including industrial machinery, automotive, medical, and home appliances, as they combine hardware and software components. Intelligent systems and networked devices have been made possible by the Internet of Things' (IoT) integration of embedded systems. The Internet of Things (IoT) is transforming industries like manufacturing, transportation, healthcare, and agriculture by facilitating smooth connectivity and data exchange. This synergy is best shown by the ESP32 microcontroller, which is perfect for Internet of Things development since it has several peripherals, real-time processing, and Wi-Fi connectivity. IoT solutions utilising ESP32 provide improved productivity, safety, and efficiency in industrial monitoring and security. By combining the microcontroller with sensors and actuators, comprehensive systems for environmental monitoring, asset tracking, predictive maintenance, and emergency response can be developed.

2 LITERATURE REVIEW

The literature review comprehensively examines the evolution and diverse applications of surveillance systems, particularly focusing on the integration of embedded and Internet of Things (IoT) technologies to enhance their functionality and efficiency. It elucidates how IoT-enabled smart surveillance systems facilitate sensor networks and remote monitoring [1,5]. Furthermore, it investigates the utilization of Wi-Fi-based security cameras, underscoring their

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significance in enabling real-time intelligent surveillance [2]. The review also addresses limitations associated with traditional surveillance methodologies such as inefficient data management and manual monitoring, proposing innovative solutions like automation and facial recognition to augment effectiveness [3,4]. Moreover, it discusses the integration of mobile devices and IoT for home automation and security purposes, exemplifying the convenience of remote control via cellular networks [6,7]. Additionally, it delves into the challenges and prospects presented by the Industrial Internet of Things (IoT), emphasizing its potential impact on surveillance systems [11]. Furthermore, it scrutinizes IoT infrastructures and their ramifications for surveillance, stressing the necessity for robust and scalable architectures [12].

3 PROPOSED METHODOLOGY

To provide real-time monitoring of industrial settings, the suggested system integrates the ESP32-DEV module with many sensors, including as temperature, smoke, and flame sensors. The ESP32 integrated Wi-Fi module makes it easier to connect to the cloud, which enables the uploading and remote monitoring of sensor data. Furthermore, the Blynk application toolkit connects the system to Android mobile devices, giving users easy access to monitoring features. The Cayenne project builder, a cloud platform for effective industrial sensor monitoring, is also integrated into the system. With Blynk, users may access the system from laptops or mobile devices and receive email or SMS warnings when sensor parameters go above predetermined thresholds. This feature is especially helpful for small businesses looking for affordable monitoring options. The system uses the ESP32-CAM to construct a surveillance system that can identify unauthorised people in addition to monitoring industrial processes. Without the need for complicated programming or other parts, the system can implement facial recognition thanks to the ESP32-CAM's small camera module and IR sensors. When unauthorised people are identified, the Blynk app sends notifications and the surveillance site activates audio alarms.

4 HARDWARE IMPLEMENTATION

4.1 *ESP32-CAM*

Based on the ESP32 microprocessor (Figure 1), the ESP32-CAM is a reasonably priced development board with an integrated camera and a small form factor. It is a great option for do-it-yourself projects, prototyping, and a variety of IoT applications. It is versatile and efficient, sporting dual high-performance 32-bit LX6 CPUs and supporting low-power BLE, conventional Bluetooth, and Wi-Fi. The board has temperature sensors, Hall sensors, and on-chip sensors. Its primary frequency may be adjusted between 80MHz and 240MHz. It can be installed as a networking module into already-existing devices or used as a network controller because it complies with Bluetooth 4.2 and Wi-Fi 802.11 standards. Applications include wireless monitoring, IoT implementations, industrial control, home automation, and QR code recognition. (For reference, see ESP32 CAM in Figure 2).

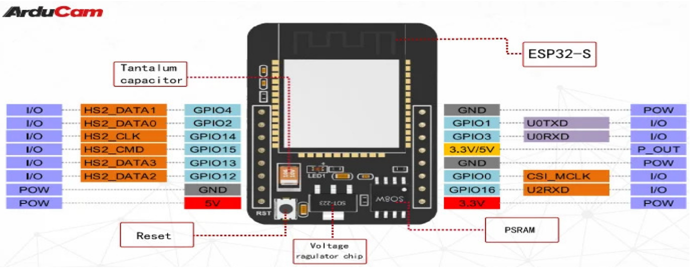


Figure 1. ESP32 CAM Pin diagram.

Figure 2. PIR sensor.

When an object is above freezing temperature, it emits or reflects infrared radiation, which can be detected by a passive infrared (PIR) sensor. Unperceptible to the naked eye, infrared radiation is released by living things as heat. PIR sensors are specifically made to pick up on these kinds of heat radiations. The word “passive” in the sensor’s name indicates that it doesn’t produce or release any energy in order to detect things.

4.2 *Flame sensor*

In industrial settings, the flame sensor serves as a guardian of safety, calibrated to detect flame intensity with amazing accuracy (Figure 3). Operating in the 760nm–1100nm wavelength band, it is remarkably capable of detecting fires up to 100cm away from its location within a broad 60 degree detection angle.

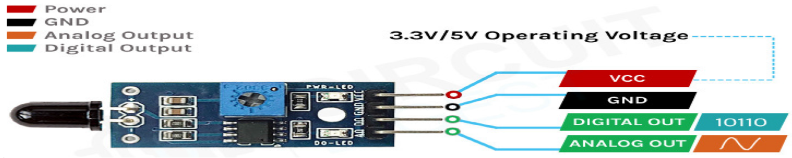
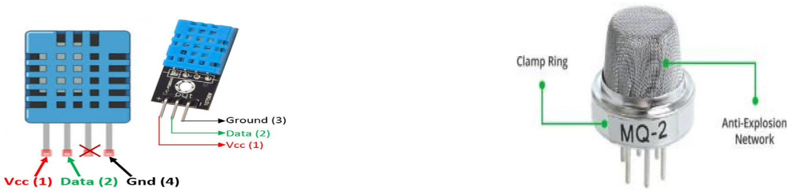


Figure 3. Flame sensor.

4.3 *Temperature sensor*

Temperature sensors are the silent sentinels that watch over the minute variations in heat with unchanging accuracy within the complex web of industrial processes. These precisely engineered sensors serve as safety bulwarks in dangerous settings, watching over vital equipment to guarantee its integrity and best possible operation (shown in Figures 4 a and b).



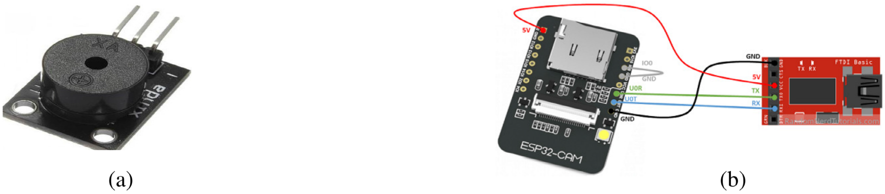
(a) (b)

Figure 4. DT11 sensor (a) and MQ2 sensor (b).

4.4 *MQ2 sensor*

In many applications, the MQ2 sensor—a flexible gas sensor module—replaces conventional smoke sensors. The MQ2 sensor is suited for fire detection systems because it uses a semiconductor-based sensing mechanism to detect a broad variety of gases, including smoke particles. The MQ2 sensor, which is outfitted with cutting-edge technology like the MC145012DW smoke detector chip, functions via an infrared photoelectric chamber, picking up smoke particles by detecting scattered light.

4.5 *Buzzer*



(a) (b)

Figure 5. Buzzer (a) and FTDI controllers (b).

An audio alert system can be created with an Arduino standard Active Alarm Module by using piezoelectric, electromechanical, or mechanical components. This Active Buzzer Module, mounted on a PCB, can produce a variety of sound tones based on the input frequency, which can be between 1.5 and 2.5 kHz (shown in Figure 5 a and b).

4.6 *FTDI controllers*

FTDI controllers to improve communication and device connectivity. It explores the design, use, and deployment of FTDI controllers across a range of sectors, including consumer electronics, education, healthcare, industrial automation, embedded systems, and telecommunications.

5 SOFTWARE INTERFACE

Blynk was created specifically for applications involving the internet of things. It functions well on Android smartphones and shows sensor data in addition to allowing remote hardware control. Elements that make up the Blynk platform (Figure 6): Toolkit for Blynk applications: enables you to use the many widgets that are accessible in the control panel to construct projects.

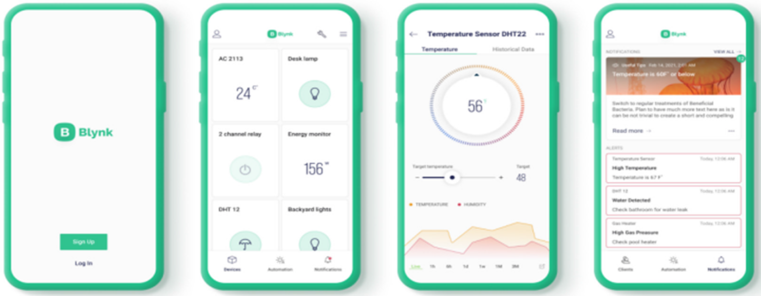


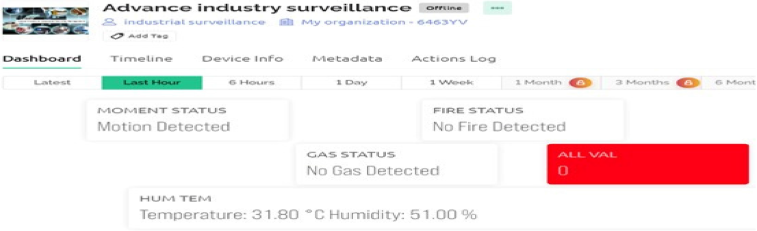
Figure 6. Blynk interface.

6 DETAILED WORKING

A complete system made for industrial surveillance applications is the ESP32 CAM Surveillance System. It makes use of the ESP32 CAM module, which is wired to an FTDI controller for data transfer and power supply control. Using a 5V battery power source, this configuration maintains portability while guaranteeing dependable operation. The technology allows for remote monitoring and analysis by streaming live video footage of the surveillance area. A Passive Infrared (PIR) sensor that is integrated into the system senses motion in the specified area. The system detects motion and sets off an alarm mechanism that includes an email notice to pre-designated recipients, a buzzer for audio alerts, and a blinking notification for visual indication. Efficient power management algorithms are employed to guarantee uninterrupted surveillance capabilities, even in places without direct power sources. Through the seamless integration of motion detection and alarm functions with video streaming, the ESP32 CAM Surveillance System provides an all-encompassing solution for improving industrial security and safety regulations.

7 RESULTS AND DISCUSSION

The Industry parameters like Temp, Humidity, MQ2, Moment are visible remotely on the Blynk app as shown in the following Figures 7, 8 and 9.



Advance industry surveillance

MOMENT STATUS
Motion Detected

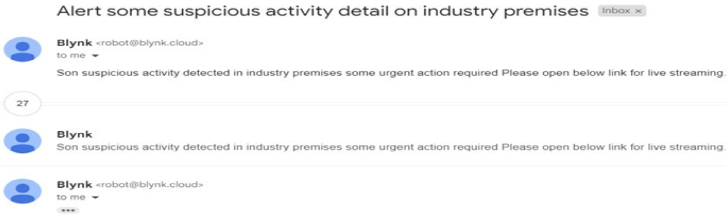
FIRE STATUS
No Fire Detected

GAS STATUS
No Gas Detected

ALL VAL
0

HUM TEM
Temperature: 31.80 °C Humidity: 51.00 %

Figure 7. Parameters displayed remotely on Blynk App.



Alert some suspicious activity detail on industry premises

Blynk <robot@blynk.cloud>
to me

Son suspicious activity detected in industry premises some urgent action required Please open below link for live streaming.

Blynk
Son suspicious activity detected in industry premises some urgent action required Please open below link for live streaming.

Blynk <robot@blynk.cloud>
to me

Figure 8. Alert send it remotely on Email for all parameters.

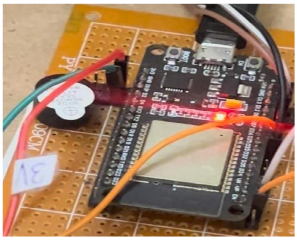


Figure 9. Buzzer for all threshold Moment detected Alert on buzzer.

8 CONCLUSION

The deployment of Internet of Things (IoT)-based security and monitoring systems shows how effective they are at improving industrial environments' resilience, efficiency, and safety. Through the use of sensors, cloud connectivity, and the ESP32 microcontroller, the system offers real-time monitoring, proactive reaction to anomalies, and remote accessibility for users. The system makes sure that the working environment is safe and safeguards assets from possible threats by continuously monitoring environmental factors and conducting security surveillance. Optimising resource utilisation, reducing downtime, and increasing operational efficiency are all achieved through the automation of emergency responses and streamlined industrial processes.

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IoT adoption with AI for enhancing operational resilience in business transformation

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ABSTRACT: The IoT is a state-of-the-art innovation in information technology that allows for the connecting of many objects over the internet. These devices may do considerable processing, actuators, and sensing. This facilitates the provision of diverse and innovative services related to intelligent systems. Integrating the IoT into corporate operations is crucial for improving operational resilience. Nevertheless, the use of IoT technology in system-supported activities is now hindered by the lack of a standardised system architecture, which is crucial for effectively managing coordination in a smart IoT environment. Business process is considered a significant methodology for the design, control, and enhancement of system processes. This report investigates the present level of Internet of Things (IoT) adoption across several personas and important verticals, highlighting a significant upward trend towards the production stage, driven mostly by digital leaders. Analysing data from business departments that actively shape IoT project goals, such as IT management, executive management, and operations management, reveals the cross-functional nature of IoT projects. Moreover, IoT facilitates the maintenance of regulatory compliance by providing verifiable records. In order to guarantee the successful integration of IoT, organisations must give priority to cybersecurity measures and establish contingency plans, therefore establishing a robust foundation for the ever-changing business environment.

Keywords: Business Processes, Enhancing Operational Resilience, IoT in Business Processes

1 INTRODUCTION

In order to keep up with the fast-corporate changes and to ensure that all departments remain honest, reliable and responsible, the development of new ways of monitoring and managing supply chains is the need of the day. Company must understand how vital IT is for improving the performance of their operations [1–3]. Through technology like the IoT, cloud computing, and big data across the supply chain to achieve supply goals and provide measurable business value [4–7]. The proliferation of interconnected smart things inside a network is the future. Implementing real-time object communication is a promising method to enhance warehouse operations and save operational expenses.

The concept of operational resilience is transitioning into a more comprehensive "business resilience" concept. Organizations must begin to see this subject as a crucial catalyst for their whole company, rather than simply an operational concern. Resilience, whether it is operational or business-related, is a crucial strategic issue that extends beyond what may seem like a problem limited to administrative functions [8]. We suggest that the Board

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should require a plan to be implemented in order to achieve operational resilience. This would help establish a common goal and a comprehensive strategy for resilience. Operational resilience is achieved via the efficient handling of operational hazards. Activities like as identifying and evaluating hazards, implementing measures to reduce risks, and monitoring the efficacy of these measures, all contribute to minimizing operational interruptions and their impacts. Furthermore, the management's emphasis on the business capacity to effectively address and bounce back from disturbances, while acknowledging the likelihood of failures, would enhance operational resilience [9]. The incorporation of IoT is not devoid of its obstacles. Significant obstacles that need meticulous study include privacy issues, interoperability challenges, and the huge amount of data collected. This article seeks to give a thorough examination of the possible obstacles to using IoT in company operations and suggests strategic frameworks for effectively addressing these issues. Moreover, a crucial element of this study is examining practical instances and notable achievements where enterprises have effectively integrated IoT to enhance their operational resilience. Through analysis of these actual cases, our aim is to extract useful insights and optimal methods that may provide guidance to other firms as they strive to develop robust operational architecture. The following paper arranged as: Section 2 provide the related work, Next Section 3–4 disucss the IoT in business or operational resiligence in IoT. Then Section 5 disuss the some adoption of the Internet of Things (IoT) across with different business or operational resiligence. Last section 6 provide the conclusion and future work.

2 LITERATURE REVIEW

According to this research, Cui (2014), supply chains' immune systems and resilience are similar in that the more we focus on resilience, the more resilient and stable the chain is. Supply chain operations will now be more straightforward and safe thanks to the synergistic impact of the knowledge and skills gained during the development of resilience and the information and network technology accumulation that advances throughout supply chain construction. It will also help to raise the level of consumer satisfaction in the interim. In this research, present a relationship model to characterise the method of using IoT to improve Supply Chain Resilience [10].

In Khan *et al.* (2023), to examine the current supply chain system and investigate the advantages that arise from the implementation of IoT embedded networks and smart products. An extensive familiarity with RFID, and short-range communication technologies forms the basis of the smart supply chain management system's concept. Also, they are confidently utilizing safe and quick inventory management and decision making. The smart carriage process, loading/unloading, transportation, storage, and packing are all featured in this study as recommendations for making sure the products are distributed safely [11].

In Allioui and Mourdi (2023), used the PRISMA as a base to conduct an incremental explanatory method. We were able to fully explore the current status of IoT research by online academic sources such as the 84 academic articles. Recognition and critical examination of present challenges constitute this study's active contribution to the ongoing discourse around IoT. New avenues for study are therefore opened, and progress in this dynamic field is encouraged, as a result [12].

According to this research, Al-Talib *et al.* (2023), in order for a supply chain to be resilient and provide businesses an edge, it has to be designed to quickly and effectively react to disruptive events and then return to its original condition. Various research have addressed the factors that facilitate SC resilience. In order to improve resilience enablers and SC resilience, this study investigates the possibilities given by the IoT [1].

The supply chain's immune system is analogous to resilience, Cui (2014), the latter is strengthened and stabilised as its maintenance efforts grow in intensity. As a result of the combined efforts of those involved in strengthening resilience and those involved in building the supply chain's infrastructure, the latter will become easier and safer to operate in the future. The level of consumer satisfaction will also increase as a result. In this research, we provide a relationship model that can be used to describe how to improve Supply Chain

Resilience by using the IoT. The following Table 1 provide the comparison of literature review [10]. This research, Yadav *et al.* (2023) focus on analytical machine learning techniques from a variety of learning types, with a particular emphasis on regressor and classification approaches. Experimental results show that, with an accuracy of 95% or above, RF (Random Forest) and Adaboost perform better than any other machine learning algorithms. The best R2 values were 91% and 89.8% for the KNN and ensemble methods, respectively. The results showed that the ensem-ble method outperformed the top ML methods in terms of R2 score, accuracy, and error value [13].

In Mannepalli *et al.* (2023) classified as requiring the implementation of DL models. The model may be adjusted to suit various scenarios by including new data, such as leaves that are healthy and those that are diseased. The efficiency of our strategy is demonstrated by a classification accuracy exceeding 95%. The development of diseases on actual farms necessitates this degree of precision. This development paves the way for specialists and farmers to swiftly execute intervention strategies that safeguard crops and their advantages [14].

In this paper, Saini and Saini (2019) highlights the need of cyber defence in the industrial and associated sectors. As they connect more and more devices and technology online, are always seeking for new ways to increase security. IoT device topologies, threat management complexity, and compliance assurance requirements [3].

In Khatoon, Roy and Pranav (2020) improve healthcare, devices enable monitoring, tracking, and administration through the use of real-time data. Data collected through the Internet of Things (IoT) is so efficient that it improves decision-making and reduces the likelihood of making mistakes. In this study, they offer a comparative overview of the IoT in healthcare [4].

In this paper, Shetye (2022) have covered the IoT and its many uses, benefits, and research obstacles. This paper's primary goal is to present an introduction to the IoT, its current state of development, and some of its most useful applications. The presentation concludes by discussing the difficulties of IoT [5].

3 INTERNET OF THINGS (IOT) IN BUSINESS PROCESS MODELLING (BPM)

Business Process Modelling refers to the process of digitally defining and/or modifying human or automated representations of a process. Due to the similarity in acronyms, Business Process Management (BPM) and Business Process Modelling may sometimes be confused with one other. company Process Modelling is the systematic approach to illustrating the processes inside an organisation or company. It allows for the examination and improvement of the current processes ("as is") in order to plan for future enhancements ("to be"). The following Figure 1 shows the business process in IoT.

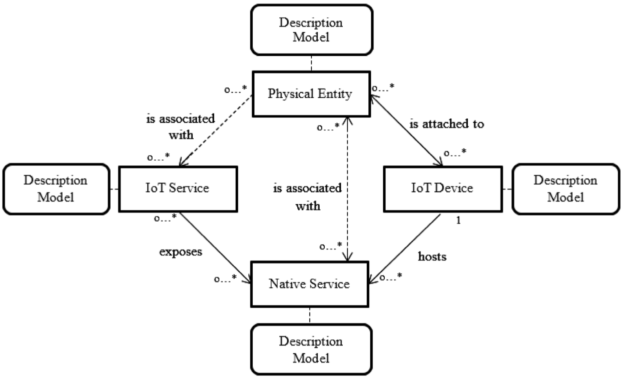

Figure 1. Business process In IOT.

4 OPERATIONAL RESILIENCE ENHANCEMENT THROUGH IOT

The term "Operational Resilience Enhancement through IoT" describes the process by which companies may fortify their operational resilience by using IoT-based solutions.

An operationally resilient organisation can swiftly resume its core activities after [9] experiencing interruptions due to cyber-attacks, system failures, natural catastrophes, or any other kind of unanticipated occurrence. The following section outlines key elements that elucidate how IoT could enhance operational resilience.

4.1 *Real-time monitoring and sensing*

It is possible to use IoT devices to deploy real-time monitoring of different business activities. Sensors, for instance, may monitor supply chain operations, equipment performance, and environmental variables.

4.2 *Predictive maintenance*

In the context of maintenance demand, IoT-powered devices, such as sensors on machine or tools, can be used as a preventive measure.

4.3 *Remote monitoring and control*

The IoT makes possible remote supervision and management of wide range of operations and structures. This function is helpful when access is limited to buildings.

4.4 *Security measures*

Digital security becomes an indispensable step to successful business continuity. IoT device security should be the top priority to stop unauthorized access and prevent various potential cyber threats.

5 DISCUSSION

The data presented offers a thorough analysis of an adoption of the IoT across different types of people and important industries, providing insight into the present and future of the corporate world. Table 1 shows that when businesses go through adoption stages, there is a marked increase in integration of IoT.

Notably, 45% of early tech adopters and 55% of digital leaders will reach the production stage over the next two years, indicating a larger tendency towards adopting the Internet of Things. This exemplifies how these personas are taking the initiative to use technology for company change. Varying degrees of Internet of Things adoption are shown by the statistics in important industry verticals including healthcare, retail, agriculture, and government. For example, with 44% currently in production, the manufacturing sector clearly has a strong grasp of how to incorporate IoT into operational operations.

Table 1. Stage of IoT adoption by persona and vertical.

		In Consideration	In next two years	In PoC	In Production
All enterprises	2019 total	9%	23%	25%	43%
Personas	Early tech adopters	5%	25%	25%	45%
	Digital leaders	5%	16%	24%	55%
Key verticals	Manufacturing	6%	25%	25%	44%
	Healthcare	12%	26%	24%	38%
	Retail	7%	36%	22%	35%
	Government	8%	18%	27%	47%

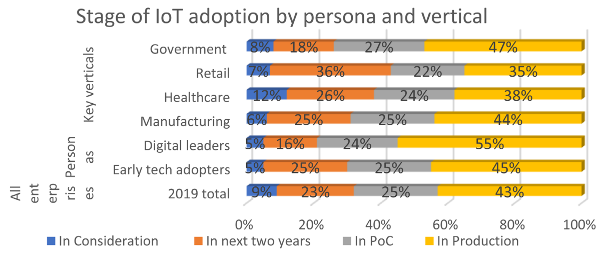

Figure 2. Bar graph of IoT adoption stages by persona and vertical.

Figure 2, a bar graph depicting the phases of Internet of Things adoption by persona and vertical, graphically highlights the differences and similarities across various industries. By providing a clear and concise picture of the existing state of operations, this visual representation facilitates the discovery of trends and patterns.

Table 2. Business functions involved in defining business goals for IoT projects.

IT management group (i.e., infrastructure managers, CIO)	51%
Executive management group (i.e., CEO, board)	45%
Operations management group (i.e.,operationalteams, COO)	37%
info security management group (i.e., CISO/CSO)	30%
Line of business, marketing, finance (i.e., LOB VPs, CFO, CMO)	28%
Digital strategy/research & development (i.e., CTO, R&D group)	22%
Network architect/engineering group	21%
Data science/data analytics group	21%
developer/applications group	20%
Third party vendors, service providers, systems integrators	15%
Other	1%

After the initial phases of adoption are complete, Table 2 dives into the business processes that are required to define the business objectives for IoT initiatives. With 51% actively participating in the development of IoT-related goals, the data implies that IT management groups play a crucial role. Because of the interdisciplinary character of IoT projects, executive management teams, operations managers, and information security managers all play important roles. This team effort is in line with the comprehensive incorporation of IoT into company plans.

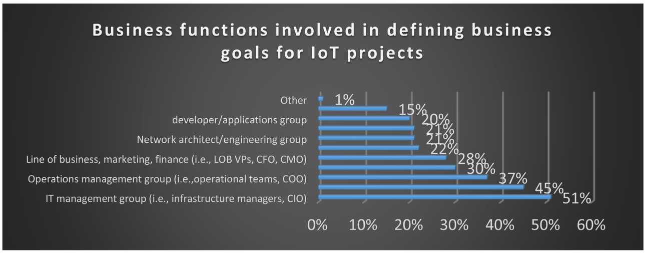

Figure 3. Bar graph of business functions involved in defining business goals for IoT projects.

Figure 3 provides a visual representation of the business processes involved in establishing the objectives of an IoT project, which supplements the data shown in the tables. It is clear that IT management and executive management groups are in charge, which highlights how important these roles are for guiding Internet of Things projects. This group effort highlights how the Internet of Things (IoT) is seen as a revolutionary force that necessitates cooperation from many parts of a company.

Finally, it is clear that there is a growing trend towards integrating AI with IoT to strengthen operational resilience throughout company change. According to the numbers, IoT adoption is going in the right direction, with the manufacturing phases getting the most attention soon. To successfully adopt and realise the revolutionary potential of IoT in business operations, it is necessary that multiple business units work together to define IoT goals. This holistic approach is crucial.

6 CONCLUSION AND FUTURE WORK

To conclusion the article, it is recommended to employ the Internet of Things application to deal with the aftermath of disruptions in supply chains and make them more effective. Here the roles played by the speed, the exchange of information, and also the flexibility are some of the factors that enhance the power of intelligent devices in reshaping the conventional supply chain. The progression operational resilience develops into a business-focused resilience strategy, hence the strategic relevance for organisations. Investigations show that IoT usage is increasing across different personas and key industries, with the manufacturing sector playing a particularly important role. Collaboration across various business units, as seen by the participation of IT, executive, and operations management, emphasises the cross-functional character of IoT efforts. The proposal is for organisations to combine AI and IoT to improve operational resilience. The surge in IoT adoption phases emphasises the importance of AI-powered solutions for real-time monitoring, predictive maintenance, and scalability. Integrating AI becomes critical for building a strong and future-proof operational foundation. Finally, the integration of IoT and AI is not only strategic, but also critical for organisations managing challenges and strengthening operational resilience as they restructure their businesses.

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IoT-powered street light management: Enhancing fault detection and reporting

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ABSTRACT: The Internet of Things (IoT) is a rapidly advancing technology that primarily focuses on linking devices or components together and with people. The automatic detection of faulty street lights has become a significant milestone achieved through this technology. The primary objective of the project is to facilitate the automatic control and identification of damaged street lights. This lighting system aims to optimize energy usage and automate operations at an affordable cost for streets, while providing immediate information about any faults in the street lights. In this proposed approach, sensors are utilized to effortlessly capture the operational status of these lights without manual intervention. This approach not only reduces manual efforts but also minimizes delays in addressing problems. To address such challenges, a solution has been devised wherein street light issues, such as whether the lights are functioning or not, are automatically detected during night-time. Notifications are then sent to authorize personnel upon detection of a problem with a particular street light, along with the location of the damaged light. The street lights are controlled automatically using IoT.

Keywords: ESP 8266, PIR, LDR sensors, IoT, Light Control

1 INTRODUCTION

The Internet of Things (IoT) is playing a crucial role in the daily lives of individuals, bringing about notable transformations in traditional systems and household components to enhance overall quality of life. A significant challenge in the current electricity system is connectivity issues, often arising from manual management by various contractors. Another issue lies in the manual setting of timers, requiring uninterrupted 12-hour power supply and posing risks of interruptions during power outages. IoT is characterized by the interconnection of real-world objects, allowing for data processing and storage while maintaining performance, confidentiality, consistency, and security. Devices connected through IoT networks offer secure and efficient solutions for various applications anytime, anywhere. IoT merges Information Technology (IT) and Operational Technology (OT), leveraging unstructured machine-generated data for improvement.

Street lighting systems, essential for road safety and urban security, face challenges such as connectivity issues, maintenance concerns, and timing inconsistencies in manual systems. These challenges can be overcome through IoT technology, ensuring smart and adaptive street lighting management. Currently, street lighting flexibility presents a significant challenge, particularly in remote areas, with human errors contributing to energy wastage and

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system inefficiencies. Research indicates that street lights consume about 30 percent of urban electricity, often remaining illuminated throughout the day due to manual control.To address these challenges, and our project proposes an effective solution through automatic ON/OFF functionality for street lights. This solution aims to reduce street light energy consumption by up to 20 percent when ambient light is available, contributing to energy conservation efforts. A standout feature of the ESP32 lies in its versatile peripheral interface, incorporating SPI, I2C, UART, ADC, DAC, GPIOs, and more. This flexibility facilitates seamless integration with an extensive array of sensors, displays, actuators, and external devices. Furthermore, the ESP32 boasts an array of built-in security features, including secure boot and flash encryption, ensuring the confidentiality and integrity of applications. This makes it an ideal choice for secure communication and IoT applications. LDR sensors find wide-ranging applications across various domains, including automatic lighting systems, display screen brightness controls, outdoor security lighting, and camera exposure regulation. In summary, the LDR sensor plays a pivotal role in light-sensitive applications, offering indispensable capabilities in detecting and responding to changes in ambient light conditions. Its versatility and reliability make it an essential component in electronics and beyond. The Passive Infrared (PIR) sensor is a crucial component utilized in motion sensing applications, finding widespread use in both residential and commercial contexts. Its operation is based on detecting infrared radiation emitted by objects within its field of view, enabling the detection of movement without requiring direct contact or illumination. Functioning by detecting changes in the infrared energy emitted by moving objects, the PIR sensor triggers a response, commonly activating lighting, security alarms, or other automated systems. This makes it a valuable asset in improving safety, security, and energy efficiency.

2 RELATED WORK

This system eliminates the need for manual intervention, offering enhanced efficiency and accuracy in managing street lighting operations. Light Dependent Resistors (LDRs) play a pivotal role in automatically switching street lights on or off based on ambient light levels. This method offers various benefits, including adaptability to seasonal changes, improved energy efficiency, and reduced operational and maintenance costs. The integration of Crouzet Millennium software further enhances the testing and analytical capabilities of the streetlight system [17]. The automatic street lights project aims to minimize power wastage and eliminate manual intervention in street lighting operations. This is achieved through the integration of sensors such as LDRs and microcontrollers, ensuring street lights remain off during daylight hours. At night, the intelligent street lighting system, leveraging GSM technology, ensures street lights are operational only when necessary, thus conserving power and reducing unnecessary energy consumption [14–16]. In conclusion, the integration of advanced technologies such as PLC, LDRs, GSM, IoT and RFID presents promising opportunities for optimizing street lighting systems, enhancing energy efficiency, and reducing operational costs. These innovative approaches pave the way for more sustainable and intelligent urban lighting solutions.

3 PROPOSED WORK

The system as shown in Figure 1 aims to emulate a near-real-time environment for an IoT-based street light control system, evaluating its performance. It utilizes ambient light sensors to detect real-time light intensity, enabling responsive control of street lights based on sensed conditions [4].

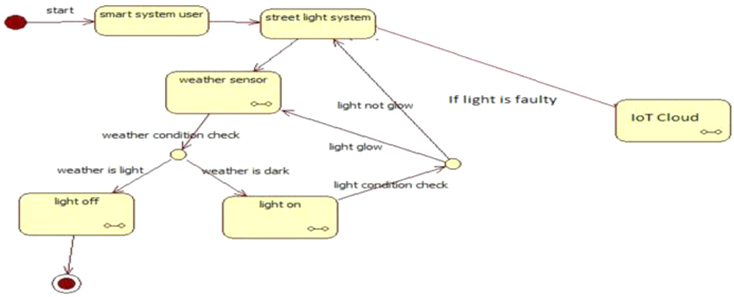

Figure 1. Street light system.

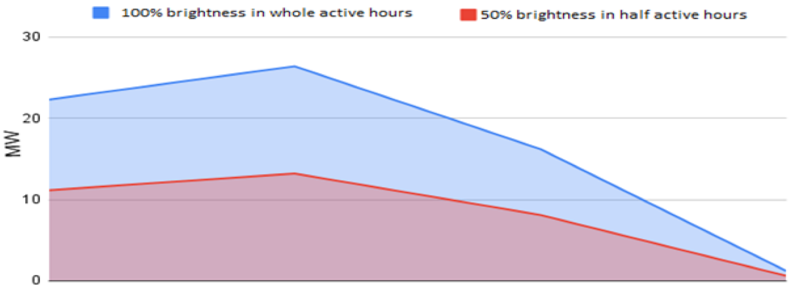

Figure 2. Energy cost comparisons with brightness level adjustment of LED streetlight.

The block diagram of the proposed system is shown in the Figure 3. The street light control and fault detection system, now enhanced with IoT technology, automates the management of street lamps and promptly identifies faults without human intervention. Instead of manual operation, the system relies on automated ON/OFF control based on weather conditions, monitored using a Light Dependent Resistor (LDR).When the weather is bright, indicating daytime, and the system activates the street lights. Conversely, during dark weather conditions, signaling nighttime, the system deactivates the street lights to conserve energy [10]. In case of faulty lights, detected through irregular LDR readings, the system immediately notifies the IoT server. Authorized personnel can then remotely access the IoT server to monitor the street lights' status and address any issues accordingly. Figure 2 explains the comparison between normal street lighting system and the Automatic LED street lighting system with Dimming methodology and proves that the proposed system has more advantage then the existing system.

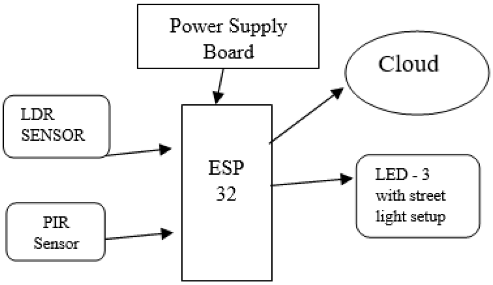

Figure 3. Proposed system block diagram.

4 CLOUD SERVER

Firebase is a comprehensive platform designed to streamline mobile and web application development by offering a diverse range of tools and services. Developers can efficiently manage authentication, real-time database synchronization, cloud storage, and hosting through Firebase's integrated suite of features. With Cloud Fire store for scalable database solutions, Cloud Functions for server less computing, and Firebase Authentication for secure user verification across multiple platforms, Firebase provides a robust foundation for app development. Its analytics tools enable developers to gain insights into user behavior, while performance monitoring aids in identifying and resolving issues promptly. Additionally, remote configuration allows for dynamic app customization, complemented by seamless integration with Google services like Crashlytics for robust crash reporting and debugging. Firebase empowers developers to create high-quality applications with enhanced user experiences and optimized performance [7].

5 CONCLUSION

The deployment of a smart street light system marks a significant leap forward in urban infrastructure management. By seamlessly integrating automatic control, fault detection, and IoT technology, the system not only enhances energy efficiency and reliability but also paves the way for a more sustainable and interconnected urban landscape.

In summary, the design and execution of a smart street light system present a promising solution to overcome the hurdles encountered by traditional street lighting systems. As cities embrace smart technologies and pursue sustainable development objectives, the adoption of Smart Street light systems will be pivotal in fostering safer, more efficient, and environmentally conscious urban environments.

6 FUTURE ENHANCEMENTS

Implementing advanced predictive analytics algorithms can anticipate potential faults in street lights based on historical data and sensor readings. By identifying patterns indicative of impending failures, maintenance can be scheduled proactively, reducing downtime and optimizing maintenance resources.

Implementing a data-driven approach to system management enables continuous improvement and iterative development. By collecting and analyzing data on system performance, user behavior, and environmental impacts.

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Li-Fi-enabled smart indoor navigation system with obstacle detection and voice assistance for visually impaired individuals

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ABSTRACT: Navigating indoor spaces poses a significant challenge for individuals with visual impairments, particularly in unfamiliar environments. Various solutions have been proposed to alleviate this difficulty. Notably, Visible Light Communication (VLC) technology, also known as Li-Fi, utilizes light as a high-speed communication medium. Our primary objective is to develop an automatic indoor navigation system tailored for individuals who are blind or visually impaired, leveraging the omnipresence of visible light. In our pursuit to aid visually impaired individuals in navigating indoor spaces, we propose the implementation of a navigation system utilizing Visible Light Communication technology. To assess the system's effectiveness, we conducted an experiment specifically designed for individuals with visual impairments. Despite the inherent challenges of acquiring precise positional information and detecting directions visually impaired individuals can now sense obstacles in front of the blind people. Additionally, we employ a zigbee transmitter to send data very rapidly and over a short period of time. a switch connected to the receiver device via a transmitter allows a blind person to activate the fan when they enter the chamber. By pressing down on a zigbee transmitter, the user can activate the switch, sending a signal to the transmitter placed in the bedroom to turn the fan on or off. Finally, this system is enhanced with an Automatic Speech Recognition (APR) voice that will use a speaker to issue instructions to blind users.

Keywords: Automatic navigation system, Speech recognition, Visible Light Communication (VLC), Transmitter-receiver system

1 INTRODUCTION

Malls and hospitals are challenging for the blind and the visually impaired to move around in. Although white canes and guide dogs are very common in the realm of blindness, they are inadequate (sometimes even counterproductive) in environments that are as crowed as mines.

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Tech is improving and so are some of the indoor travel assistance systems increasingly delivered with Li-Fi, IR or ultrasonic sensors or APR voice from Scarlett Development Group. In this project, Arduino framework is used to develop a device that uses sensors to avoid obstacles and give voice commands through the speaker. Real-time navigation through ultrasonic sensors along with Automatic Speech Recognition (ASR) system enhances the navigation for visually impaired people. Ultimately our aim is to create open source solutions for the vision-impaired that will greatly improve their indoor way finding and autonomy.

2 RELATED WORK

2.1 *Versatile navigation solutions for seamless pedestrian experience in both indoor and outdoor environments*

This study introduces navigation solutions engineered to provide a smooth and intuitive pedestrian experience across a spectrum of environments, encompassing both indoor and outdoor settings. Leveraging advanced technologies such as Global Positioning System (GPS), Augmented Reality (AR), and sensor fusion, our approach aims to address the challenges of navigation in diverse contexts. The integration of real-time GPS data and AR overlays on mobile devices offers users contextual visual cues for effective navigation. By incorporating sensor fusion techniques, the system enhances location accuracy and adapts dynamically to changes in the environment, irrespective of whether the user is indoors or outdoors. Furthermore, machine learning algorithms continuously optimize the navigation experience, considering user preferences, historical data, and real-time environmental factors [1].

2.2 *Enhancing interior guidance for individuals with visual impairments through smartphone-based solutions: Incorporating users information model*

In a person's daily existence, being able to move from one area to another is a crucial action. Blind people, however, are significantly hampered by their visual impairment, making it difficult for them to do this exercise. For blind people, navigation is an essential skill because they can only go along fixed paths that are necessary for their survival. Blind people find it challenging to live and work in this setting, among other reasons. Blind individuals have equal access to the resources of the world and are a significant and inevitable part of our community. Existing navigational aids for the blind put them under more cognitive strain by asking them to memorize several POIs, which adversely affects their performance and causes dissatisfaction. It is well known that being unable to walk on one's own may restrict one's ability to engage in society [2].

2.3 *A cheap smart navigation device can be useful for blind people*

An affordable smart navigation device has emerged as a highly beneficial tool for individuals with visual impairments, particularly those who are blind. This device serves as a crucial aid, offering an intuitive and cost-effective solution to support independent mobility and navigation for individuals facing visual challenges [12]. By leveraging advanced technologies, this smart navigation device provides real-time assistance, helping users navigate their surroundings with ease and confidence. The affordability of this solution makes it more accessible to a broader demographic, addressing a critical need for inclusive and assistive technologies that enhance the quality of life for individuals with visual impairments [3].

2.4 *Wearable navigational aid for blind virtual guidance*

Wearing a navigation device while moving from one location to another is made possible by this technology for the blind. This might also give directions for walking through cities. The blind could sidestep the obstruction by using the ultrasonic sensor. They have the ability to perceive things in front of, behind, and to the left and right of the blind person. Camera that takes a picture of the target and sends it to the Raspberry Pi board [11]. Python is used to programme the Raspberry Pi motherboard. The image will then be transformed into a speech or voice signal using the optical character recognition concept. Hence, the name of the thing, the directional sign, etc., may all be heard by the blind. It can also be used for navigating inside buildings. It can be transported anywhere because the battery serves as the power source. Because some adults and kids have difficulty reading the text, this uses TTS software. Documents, e-pages, and web news are, however, easily converted into speech signals. It enables the ship to find its own way around. Comparable systems lack some of the qualities that the proposed system possesses [4].

2.5 *Utilizing ultra-wide-band technology and dead reckoning algorithms for navigation enhancement*

The integration of Ultra-Wide-Band (UWB) technology with Dead Reckoning (DR) algorithms presents a potent synergy for advanced navigation systems. UWB, known for its precision in indoor positioning, and DR, a technique for estimating the current position based on a previously determined position, combine to offer a robust solution for accurate and reliable navigation in various scenarios. Ultra-Wide-Band technology operates by using a broad spectrum of radio frequencies to enable highly accurate distance measurements between devices [10]. When coupled with Dead Reckoning algorithms, which rely on data from sensors like accelerometers and gyroscopes to estimate movement, the resulting navigation system excels in environments where traditional GPS signals may be limited or unavailable, such as indoor spaces or urban canyons [5].

2.6 *Smart sticks help blind people*

Blind people who are constantly striving to blend in with their surroundings are highlighted in this study. Moreover, their daily tasks are significantly limited as a result of their vision loss. Therefore, it is essential to discover a simple method of acquainting them with a location or a route around the globe. The objects those walking poles come into contact with can be detected. The writers used the Raspberry Pi to build a clever stick as an electronic tool to solve this problem [9]. The suggested gadget detects an item nearby and transmits speech information, alert messages through headphones, and GPS navigation to a specific place. The intelligent stick's greatest objective is to enable blind people to walk independently while providing a minimal amount of effective direction-finding and blockage-detecting assistance. It does this by giving data about the environmental situation of nearby stationary as well as moving objects [6].

2.7 *The robot assistant will navigate using light communication.*

A robot that uses visible light communication (VLC) methods to guide blind people through indoor navigation was developed in this study. Each VLC LED lamp transmits a movement control signal, which decides the direction of the moving robot [8]. The route planning system, aligned with user preferences, computes either the shortest distance or the user's preferred path from the current location to the destination, considering specified waypoints. Comprising a VLC robot, multiple VLC LED lamps, a server, and a smartphone equipped with a controller app, the system orchestrates seamless navigation tailored to individual user choices [7].

3 IMPLEMENTATION

Li-Fi technology is used in the proposed indoor navigation system as shown in Figure 1 to facilitate seamless communication between Li-Fi receivers such as photodetectors integrated into user devices like smartphones and navigation aids and strategically positioned Li-Fi transmitters represented by LEDs within the environment. Proximity sensors or cameras are used to improve obstacle identification, and real-time obstacle data is smoothly incorporated into the Li-Fi system [13]. With the thoughtful integration of Zigbee transmitters for appliances and user input devices, Li-Fi systems provide fast data transfer across devices via linked Zigbee receivers. Zigbee transmitters are used to provide control signals to the Li-Fi network, while tactile switches or touch-sensitive interfaces are used to facilitate user engagement. Easily included into the Li-Fi system, an Automatic Speech Recognition (APR) technology enhances user interaction by recognizing voice instructions.

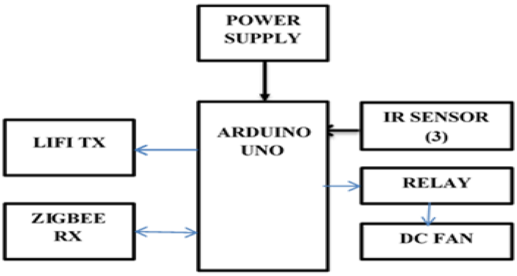


Figure 1. Proposed indoor navigation system.

3.1 *Switch control logic*

The Switch control logic is important to interpret the user inputs from switches to control signals for appliances which makes the human-device interaction much more fascinating. Combining the EEL Embedded Automatic Speech Recognition (APR) system with Li-Fi infrastructure leads to glitch-free communication and delivers voice commands accurately, enhancing user experience. Critical information such as obstacle alerts and appliance controls are displayed on a user-friendly interface on the users device making it a breeze for the visually impaired users to navigate the system. Our system is mainly dependent on the Arduino Uno microcontroller which keeps track of operations by assessing the inputs of the sensors and also keeps processing operating by providing continuous power supply. The ultrasonic sensor mounted on the cane in front of the user measures the distance to an obstacle and sends notifications when this distance is breached. As seen in Figure 2, Li-Fi technology plays a vital role to communicate with the user by transmitting data with light which is detected by photodiode andvice versa.

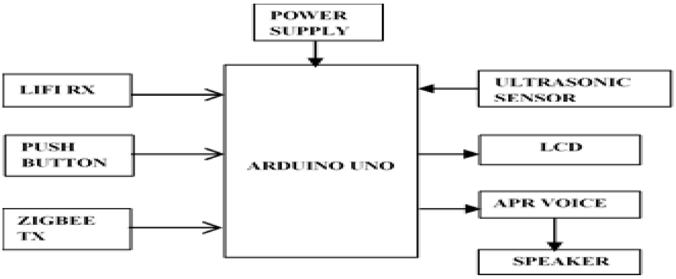
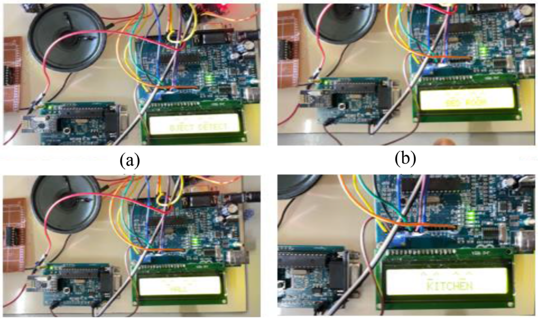


Figure 2. Receiver.

The Push Button functions as the user interface, allowing orders to be initiated with ease. Connectivity with other systems or devices is made possible by the Zigbee Transmitter (ZIGBEE TX). An LCD display displaying real-time information, directions, and obstacle distances is one of the output devices that guarantees user awareness. Voice commands are enabled by means of the APR Voice Module, and audio output is clarified by means of a Speaker, so augmenting the effectiveness of communication.

3.2 *Working modules*

Ultrasonic sensors find extensive applications, especially in robotics and automation, where they play a crucial role in accurate obstacle detection and distance measurement is shown in Figure 3. Operating on the echolocation principle, these sensors emit ultrasonic waves, measuring the precise time it takes for these waves to reflect back after encountering an object. When an obstacle is present, the sensor calculates the distance based on the time delay, allowing the system to discern the object's proximity. This technology is crucial in creating obstacle-avoidance systems for robots, ensuring they can navigate their surroundings effectively. Ultrasonic sensors are known for their reliability, versatility, and ease of integration, making them a popular choice in a diverse range of industries for tasks ranging from simple distance measurement to complex obstacle detection and avoidance.



(a) (b) (c) (d)

Figure 3. Sensors detection (a) obstacles (b) bed room (c) hall (d) kitchen.

In the context of using an infrared (IR) sensor to detect activity or occupancy within a bedroom, the sensor serves as a valuable component in home automation and security systems. Infrared sensors can be employed to detect the presence of individuals in a room by measuring the infrared radiation emitted by their bodies. These sensors are sensitive to heat, and when a person enters the field of detection, the temperature change triggers the sensor. In a bedroom setting, an IR sensor can be integrated into a smart home system to automate various functions [15]. For instance, it can be used to turn on or off lights based on occupancy, enhancing energy efficiency. Additionally, the sensor could contribute to security applications by alerting homeowners to unexpected movements within the bedroom, serving as a part of an intruder detection system.IR sensors are designed to detect changes in infrared radiation, typically emitted by warm objects such as the human body [14]. IR sensors can detect the presence of individuals in the hall by capturing the heat signatures of their bodies. This information can be utilized to automate lighting systems, turning lights on when motion is detected and off when the area is unoccupied. This promotes energy efficiency by ensuring that lights are only active when needed. IR sensors can be strategically placed in the kitchen to detect the presence of individuals.

4 RESULT AND DISCUSSION

Research on Li-Fi-based indoor positioning systems indicates their capability to furnish precise and real-time location information without necessitating additional infrastructure. Furthermore, these systems offer high-speed communication characterized by low latency and minimal interference. Performance analysis of Li-Fi-based indoor positioning systems yielded promising outcomes, featuring an average positioning error of under 30 cm and an accuracy exceeding 90%. Notably, the system demonstrated robust stability over time, maintaining accuracy even in the presence of obstacles and environmental changes. However, the results obtained so far are encouraging and demonstrate the potential of Li-Fi in improving the mobility and independence of the visually impaired. In conclusion, Li-Fi technology has the potential to provide accurate and real-time indoor positioning information for visually impaired people, enabling them to navigate indoor environments independently. However, further research and development are necessary to refine and optimize the technology and address issues such as scalability and cost-effectiveness.

5 FUTURE SCOPE

Prospective paths for progress are presented by the future trajectory of indoor aid training for the blind and visually impaired. In order to provide a more thorough and customized travel support experience, one important direction is the integration of Li-Fi-based indoor navigation systems with a variety of cutting-edge technologies. With regard to indoor navigation, user engagement, and environmental awareness, this integration attempts to offer a comprehensive solution that takes into account these factors.

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License plate recognition using computer vision

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ABSTRACT: A web-based “License Plate Recognition, System” that uses OpenCV and Easy OCR is introduced in the study. With the use of this technology, it is simpler to upload car photographs and properly identify and extract license plate numbers. Due to the use of computer vision and OCR technology, it is a helpful tool for a range of vehicle-related applications, including traffic control and automatic registration. By allowing users to rapidly upload photos and receive results, the user-friendly interface increases accessibility. To enhance the system’s visual attractiveness, Lottie animations are included. This not only makes it functional and aesthetically pleasing, but also appropriate for a range of areas. The study offers a practical answer for practical applications while making a contribution to the fields of computer vision and license plate identification. Industries where license plate recognition plays a crucial role may undergo a revolution thanks to the system’s adaptability, simplicity and precision.

Keywords: License Plate Recognition System, OpenCV, Easy OCR, Vehicle images, Computer Vision, OCR Technologies, User-Friendly Interface, Real-world Applications

1 INTRODUCTION

In recent years, the relevance of License Plate Recognition (LPR) technology has risen dramatically, having a significant impact on many aspects of our everyday lives, from effective traffic management to bolstered security and simplified administrative procedures. LPR systems have ushered in a new era of ease and productivity by making it possible for vehicles to be automatically identified by their license plate numbers being recognized and extracted from photographs. In a variety of industries, it has the potential to profoundly change how we handle and interact with data linked to vehicles. Historically, LPR systems have used computer vision techniques to locate and isolate license plates within images. LPR systems have evolved through time. OCR technologies are then applied to these plates to recover alphanumeric characters. It has been a significant challenge to make this cutting-edge technology more widely available while keeping crucial attributes like accuracy and efficiency.

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2 BACKGROUND & RELATED WORKS

Harnessing OpenCV and Pytesseract, our Automatic License Plate Recognition (ANPR) system demonstrates robustness in handling image noise, be it environmental or from photographic artifacts. This resilience ensures seamless performance regardless of weather conditions or surroundings, as validated by a 2023 study. With a focus on scalability, we continue to push the boundaries of ANPR technology. [1]

Published in 2022, the research focuses on preliminary results of a deep learning model trained on a dataset, utilizing a powerful Nvidia P6000 GPU. TensorFlow and Keras were the main libraries used for model training, maintaining the original train-test distribution with a 90-10 split for training and validation. Model performance was evaluated based on accuracy, revealing promising initial observations. [2]

The paper by M. Al-Mheiri, O. Kaisi, and T. Bonny proposes a machine learning-based smart car number plate recognition system, expanding on previous Automatic Number Plate Recognition (ANPR) research. It aligns with established ANPR techniques utilizing computer vision and machine learning for various applications. Notable advancements include incorporating SMS notifications for tracking, adding novelty to the system's functionality. [3]

In 2021, the integration of OpenCV and OCR technologies in ALPR systems gained traction, enabling efficient text extraction from license plates in varied environments. These advancements found applications in security, parking management, and traffic control. Furthermore, research highlighted the significance of photo text extraction and document digitization, enhancing data access and analysis. Such systems offer managers valuable insights into vehicle information, bolstering objectives in traffic management, security, and automatic vehicle recognition. [4]

C. Henry, S. Y. Ahn and S.-W. Lee of 2021, which describes a general string recognition system for automatic license plate recognition (ALPR). Using different techniques, researchers have focused on increasing the efficiency and accuracy of ALPR. Recurrent neural networks (RNNs), end-to-end ALPR systems, and convolutional neural networks (CNNs) are some notable examples of recurrent work that use deep learning techniques to improve detection performance. This demonstrates the continued relevance and expansion of ALPR technology worldwide. [5]

The authors of a related work introduced a real-time vehicle number plate recognition system using Raspberry Pi and OpenCV, featuring PIR sensors for vehicle detection. Their approach aligns with the objectives of the proposed solution, emphasizing efficient license plate recognition and vehicle detection through real-time image processing, showcasing practical application of similar techniques. [6]

The paper presents an enhanced license plate recognition system employing a modified YOLOv3 model and OCR for accuracy improvement. It divides functionality into three stages, each utilizing a tailored YOLOv3 model. The system demonstrates proficiency in recognizing and converting regional language license plates, showcasing versatility and adaptability.

The project aims to develop a cost-effective and efficient Automatic Number Plate Recognition (ANPR) system, crucial due to the challenge of manual tracking amidst vehicle diversity. Utilizing "victim segmentation," the system captures vehicle images at crossings, employs OCR for character identification on license plates, and compares data with existing records for verification. [8]

3 METHODOLOGY

Using the Stream lit, OpenCV, Easy OCR, and Python libraries, and the provided code creates a web application for License Plate Recognition (LPR). [9] The two primary sections are "Detection" and "About." Vehicle license plate images can be uploaded by users and processed by the application. It extracts text using Easy OCR and detects plates using Haar cascade. Plate numbers that have been detected are shown and can be downloaded in CSV format. Along with user guidance, Lottie animations, and a thorough "About" section, the application also offers visual elements. Error correction and potential upgrades are taken into account. From traffic management to security and automated registration, this LPR app fulfils a number of useful functions. The application prompts users to upload an image when they interact with the "Detection" section. There should be a car in this picture with a visible license plate. Users can select an image from their local device using this application. Users are able to upload images in JPG, JPEG, and PNG formats, among others. The program gives the user access to a file uploader component by utilizing Stream lit, a Python package for building web applications. Users can choose an image file from their computer or mobile device using this component. Display of Uploaded Images: The application shows the uploaded image in the left column of the user interface after the user chooses and uploads an image. [10] Users can visually verify that the uploaded image is the one they want to use for license plate recognition. Figure 1 shows the architecture of the proposed model.

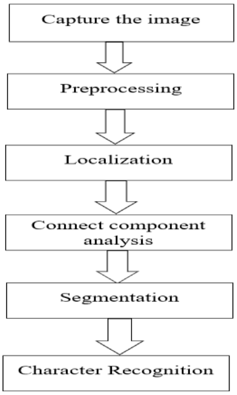


Figure 1. Architecture of proposed model.

3.1 *Transformation of grayscale*

As part of the preprocessing steps, the uploaded color image must first be converted to grayscale. [11] By reducing the image to a single channel, this conversion improves processing efficiency and facilitates further processing. Furthermore, color and lighting changes have less of an effect on grayscale images.

3.2 *Determining the regions of license plates*

Using the automobile number plate data from the Haar cascade XML file, a cascading classifier is used to find potential number plate regions within the grayscale image. [12] The classifier looks for patterns that resemble license plate designs, such as rectangular shapes and other features. The identified areas may be where license plates are present.

3.3 *Region extraction*

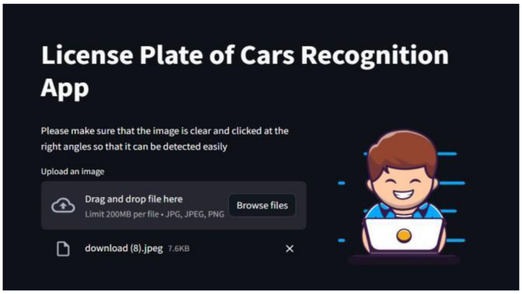
Once they have been identified, the program extracts and saves the potential license plate regions as separate images. [13] The accuracy of text recognition can be improved by processing each potential license plate separately thanks to the data separation.

3.4 *Text recognition*

In the License Plate Recognition (LPR) project, text recognition is pivotal in preprocessing, employing the Easy OCR library for license plate area extraction and text extraction [14]. Content component analysis involves locating and extracting license plate regions, followed by Easy OCR-based text recognition [14]. This ensures efficient and reliable license plate recognition, benefiting applications such as traffic management [14]. Character segmentation isolates individual characters for processing, using various techniques like defining regions and identifying boundaries [15]. Segmented characters undergo separate Easy OCR processing, enabling identification and verification before CSV download [15]. Overall, the project workflow includes image uploading, conversion to grayscale, Haar cascade method for license plate recognition, EasyOCR for text recognition, and displaying recognized plates for verification and CSV download [15].

4 EXPERIMENTAION AND RESULTS

Most of the output in the code provided for the License Plate Recognition (LPR) project consists of the following components:



License Plate of Cars Recognition App

Please make sure that the image is clear and clicked at the right angles so that it can be detected easily

Upload an image

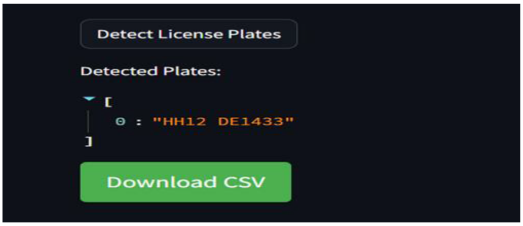
Drag and drop file here

Limit 200MB per file • JPG, JPEG, PNG

download (8).jpeg 7.6KB

Figure 2. Display of uploaded images display of uploaded images.

The application displays an image in the left column of the user interface when the user uploads a picture. With this display, users can visually confirm that the photo they uploaded is the one they wish to use for license plate recognition (Figures 2 and 3).



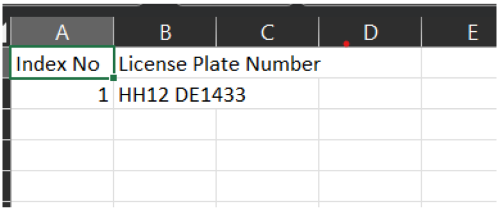
Detected Plates:

```
[
  0 : "HH12 DE1433"
]
```

Figure 3. Detected license plates.

4.1 *Detected license plates*

The system analyses the user's uploaded image and recognize s the license plates and their text after the user clicks the “Detect License Plates” button. The right column of the user interface displays the identified text for the detected license plates. Users can visually inspect the recognize d license plate numbers.



A	B	C	D	E
Index No	License Plate Number			
1	HH12 DE1433			

Figure 4. CSV export.

4.2 *CSV export (shown in Figure 4)*

Through a download link in the right column, users can obtain the recognize d license plate numbers in CSV format in addition to viewing the recognize d license plates through the application. By clicking this link, users can download a CSV file containing the data from the recognize d license plate. Users can store the identified data for later use or documentation with the aid of this feature.

5 CONCLUSION

The License Plate Recognition (LPR) project provides a reliable method for automatically identifying license plates in images using image processing, EasyOCR, and Haar cascade-based detection. Through experimental validation, the project ensures accuracy and utility, catering to real-world needs in security and traffic control. By simplifying car identification and enhancing automation, it increases efficiency. Its user-friendly interface and CSV export feature enhance accessibility across various scenarios. Continual improvement and user feedback are pivotal for its sustained positive impact in fields reliant on license plate recognition.

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Multi-sensor approach leveraging IoT for comprehensive wildlife conservation: Addressing threats and enhancing monitoring efficiency

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ABSTRACT: This research explores the integration of Internet of Things (IoT) technology with a multisensory framework for enhanced wildlife conservation efforts. The study addresses pressing challenges such as animal hunting, deforestation, habitat fragmentation, and road accidents. Existing technologies often lack comprehensive, real-time monitoring capabilities for timely threat detection and response. The proposed system leverages a strategic combination of sound detection, accelerometers, Passive Infrared (PIR) sensors, and Radio-Frequency Identification (RFID) sensors to address these challenges. Specifically, the framework aims to detect animal hunting (via acoustic analysis), tree falling (using vibration data), animal-vehicle collisions (through PIR sensors), and track animal movement patterns (using RFID tagging). This research offers a scalable and efficient solution for real-time wildlife monitoring and threat detection, contributing to advancements in wildlife conservation practices across various ecosystems.

Keywords: IoT (Internet of Things), Wildlife conservation, Sensor networks, Real-time monitoring, Threat detection, Threat mitigation, Animal tracking

1 INTRODUCTION

Wildlife conservation faces significant challenges such as poaching, deforestation, and habitat destruction, with traditional monitoring methods often failing to provide timely and accurate data. This paper introduces a comprehensive IoT-based system designed to enhance wildlife monitoring and protection by detecting animal hunting, tree falling, animal-vehicle collisions, and tracking animal activity. By integrating multiple sensors, including sound detection, accelerometers, PIR sensors, and RFID sensors, the system offers real-time threat detection and response. This innovative approach aims to fill the research gap in comprehensive monitoring systems and advance wildlife conservation practices, promoting sustainable coexistence between humans and wildlife. The paper includes a literature survey and discussion of related studies and their gaps (Sections 27.1 and 27.2), proposes an architecture for the wildlife study (Section 27.3), details the experiment and discussions (Section 27.4), analyzes the results with output snapshots (Section 27.5), and concludes the paper (Section 27.6).

2 LITERATURE SURVEY

In recent years, there has been significant interest in exploring the potential of Internet of Things (IoT) technology for wildlife conservation efforts [1–3]. Researchers have demonstrated the effectiveness of IoT-based tracking devices in monitoring animal movements and behaviors, thereby aiding in habitat conservation endeavors [4]. Moreover, integrating

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multiple sensors has emerged as a promising approach for wildlife monitoring, as evidenced by studies proposing systems that combine camera traps, GPS collars, and acoustic sensors to track endangered species and inform conservation planning [5]. Real-time threat detection is another crucial aspect of wildlife conservation, with IoT-enabled systems capable of identifying poaching activities through acoustic analysis, enabling swift intervention by conservation authorities [6]. Furthermore, remote sensing techniques, including the use of satellite imagery and IoT sensors, have been instrumental in monitoring deforestation activities in protected areas, providing valuable data for conservation management and policy-making [7]. Despite these advancements, challenges such as sensor durability, data transmission in remote areas, and cost-effectiveness persist in implementing IoT solutions for wildlife conservation. However, there are ample opportunities to leverage IoT technology to enhance conservation efforts and mitigate human-wildlife conflicts. Ethical considerations surrounding the use of IoT in wildlife conservation cannot be overlooked, emphasizing the need for ethical data collection practices, privacy protection for wildlife and local communities, and stakeholder involvement in conservation decision-making processes [8]. Looking ahead, future research should focus on developing scalable and interoperable IoT platforms tailored to diverse ecosystems and wildlife species, while also prioritizing standardization of data collection protocols, fostering interdisciplinary collaborations, and integrating local knowledge into conservation initiatives to achieve conservation.

3 METHODOLOGY

The methodology employed in the proposed wildlife safeguard system comprises several intricately designed components aimed at enhancing real-time threat detection and response withinhabitats [9,10,18]. Firstly, as shown in Figure 1, the system utilizes specialized sound detection sensors strategically positioned across the habitat to continuously monitor ambient sound levels for signs of hunting activities, such as gunfire.

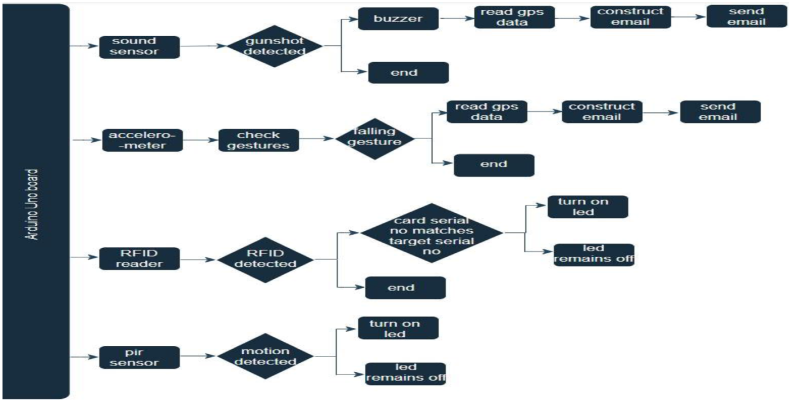


Figure 1. Design of wildlife safeguard system.

These sensors transmit collected data wirelessly to a central processing unit, where sophisticated algorithms analyze the sound patterns and trigger alerts upon detecting suspicious activity [11,12]. Additionally, accelerometer sensors integrated into sensor nodes distributed throughout the habitat monitor tree movement to identify instances of illegal logging. Any deviations from normal tree movement are promptly relayed to the central data collection point for analysis, enabling rapid intervention. Along roadways near wildlife habitats, Passive Infrared (PIR) sensors detect animal presence and trigger warning systems to alert drivers, mitigating the risk of collisions. Furthermore, Radio-Frequency Identification (RFID) sensors embedded in collars or tags worn by target animal species facilitate precise tracking of their movements within the habitat [13–15]. The data collected by these sensors are transmitted to the central processing unit, where advanced algorithms analyze animal behavior and generate alerts in response to any anomalies or unauthorized access to restricted areas. As shown in Figure 1, this comprehensive methodology involves meticulous deployment of sensor infrastructure, continuous data monitoring, and rigorous performance validation to ensure the system's effectiveness in safeguarding wildlife habitats.

Challenges encountered during implementation are systematically addressed to enhance the reliability and accuracy of data collection processes, ultimately empowering conservation authorities with actionable insights for effective wildlife management. Real implementations of this study is shown in Figure 2.

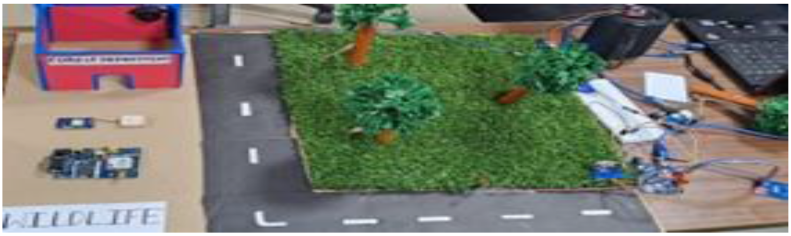


Figure 2. Prototype of wildlife safeguard.

4 PROPOSED ARCHITECTURE

Wildlife Safeguard study architecture is comprising of variety of sensors to collect the data and cloud environment to analyze the data. As shown in Figure 3 below, Sound sensor, Accelerometer sensor, PIR sensor and RFID sensor. For animal hunting detection, the system employs sound detection sensors strategically placed across the wildlife habitat. These sensors continuously monitor sound levels, particularly those indicative of gunshots or other hunting activities. Data collected from these sensors is transmitted wirelessly to a central data processing unit. Upon detection of suspicious sound patterns, the system triggers an alert mechanism to notify wildlife authorities [16], enabling prompt intervention. As shown in Figure 4. For tree falling detection, the architecture integrates accelerometer sensors into the sensor nodes distributed throughout the habitat. These sensors detect changes in tree movement and axis changes in tree coordinates, such as those caused by illegal logging activities [17]. Data from accelerometers are processed locally and transmitted to the central data collection point. When significant deviations from normal tree movement are detected, as shown in Figure 5, the system generates alerts to notify relevant authorities, facilitating rapid response to illegal logging incidents.

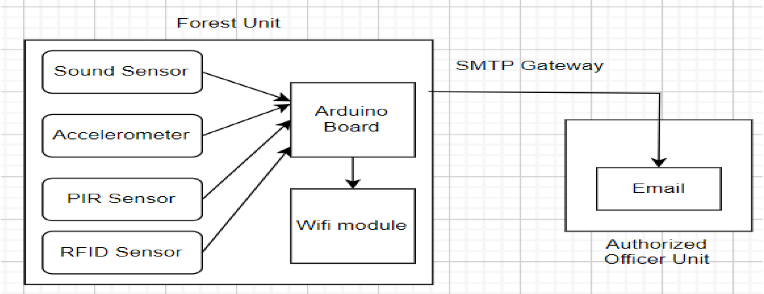


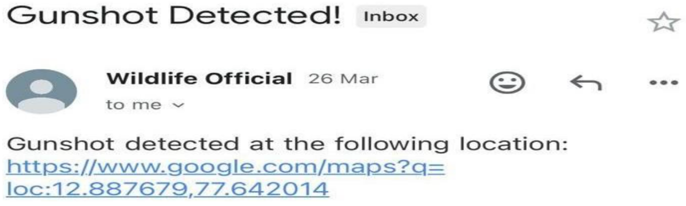
Figure 3. Architecture of wildlife safeguard system.

For animal-vehicle collision detection, the system utilizes Passive Infrared (PIR) sensors positioned along roads and highways near wildlife habitats. These sensors detect the presence of animals crossing the road, triggering a warning system to alert drivers and reduce the risk of collisions. Data collected by PIR sensors are transmitted wirelessly to the central processing unit, which analyzes the information and generates alerts in real-time. This enables authorities to implement mitigation measures such as wildlife crossings or speed restrictions to prevent accidents.

For animal activity tracking, the architecture incorporates Radio-Frequency Identification (RFID) sensors embedded in collars or tags worn by target animal species. RFID sensors detect when animals cross designated zones within the habitat, signalling their movement patterns. Data collected by RFID sensors are transmitted to the central data processing unit, where algorithms analyze the information to track animal movements and behaviour. As shown in Figure 3 authorities receive alerts when animals venture into restricted areas or exhibit abnormal activity, facilitating effective management and conservation efforts.

5 EXPERIMENTAL SETUP AND VALIDATION

The experimental setup for validating the proposed architecture of the IoT-based wildlife safeguard system involves a meticulously planned deployment of sensor nodes and data collection procedures to assess the functionality as presented in Figure 3 above, and effectiveness of each component in real-world scenarios. Sound detection sensors, accelerometer sensors, Passive Infrared (PIR) sensors, and Radio-Frequency Identification (RFID) sensors are strategically positioned across designated wildlife habitats, covering areas susceptible to illegal hunting activities, trees vulnerable to illegal logging, roadways adjacent to wildlife habitats, and animals for activity tracking, respectively. Continuous data collection procedures are established to capture sensor readings over predetermined periods, ensuring comprehensive coverage of relevant parameters. Simulated events, including controlled hunting and logging activities, simulated animal crossings as shown in Figure 6, and orchestrated animal movements, are introduced to evaluate system responsiveness and accuracy. Performance validation involves comparing sensor data and detected events with ground truth data. Obtained through manual observation, wildlife authorities' records, and controlled experiments, while key performance metrics such as detection accuracy and response time are evaluated to assess system effectiveness. Challenges encountered during implementation, such as sensor and communication issues, are documented and systematically addressed through calibration techniques and mitigation strategies, ensuring accurate and reliable data collection throughout the experimentation phase.



Gunshot Detected!

Wildlife Official 26 Mar

to me

Gunshot detected at the following location:
https://www.google.com/maps?q=loc:12.887679,77.642014

Figure 4. Email alert with location.

6 RESULT AND DISCUSSIONS

The implementation of the IoT-based wildlife safeguard system demonstrated its efficacy in real-time threat detection and response. Across various scenarios, including illegal hunting, tree falling, and animal-vehicle collisions, the system's deployed sensors effectively captured pertinent data.

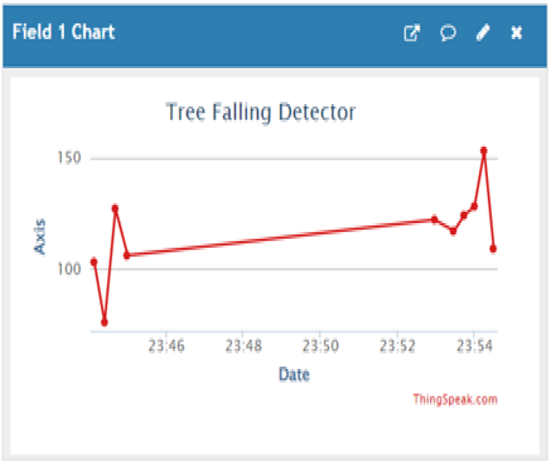


Figure 5. Tree falling detector Thing Speak Visualization.

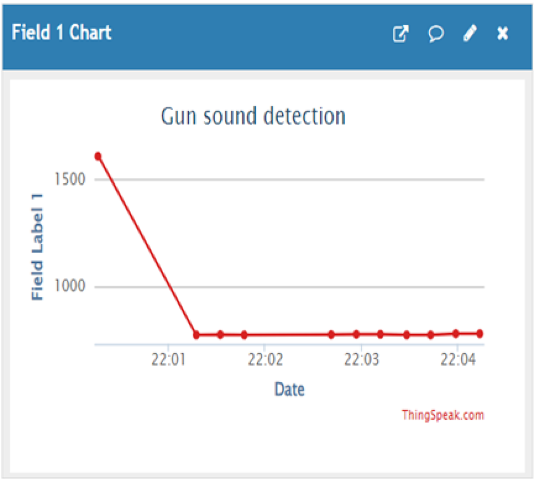


Figure 6. Gunshot detection Thing Speak Visualization.

Sound detection sensors accurately identified gunshots, while accelerometers detected abnormal tree movements indicative of illegal logging. PIR sensors along roadways successfully detected animal presence, and RFID sensors provided valuable insights into animal activity. Upon detection of suspicious activities, the system promptly generated alerts transmitted to the forest officer unit via an SMTP gateway as shown below in Figure 4. A pivotal demonstration of the system's practical application was the receipt of email alerts containing precise locations of detected threats, providing tangible evidence of its functionality. This real-time alerting mechanism underscores the system's ability to facilitate proactive conservation efforts and enables swift intervention by relevant authorities.

7 CONCLUSION

In conclusion, the development and implementation of the IoT-based wildlife safeguard system represent a significant advancement in wildlife conservation technology. Through the unity ofmultiple sensors and real-time communication capabilities, the system has demonstrated its effectiveness in detecting and responding to threats in wildlife habitats. The results of field experiments validate the system's ability to identify illegal activities such as hunting, logging, and animal-vehicle collisions, enabling prompt intervention by relevant authorities. The practical application of the system, as evidenced by the receipt of email alerts containing precise locations of detected threats, underscores its role in facilitating proactive conservation efforts. Furthermore, the scalability and adaptability of the system hold promise for its broader application in diverse ecosystems worldwide. As we continue to refine and optimise the system's algorithms and infrastructure, it is poised to make a significant impact on wildlife conservation efforts, contributing to the preservation of biodiversity and the sustainable management of natural resources for future generations.

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Smart care for asthma: A machine learning-based CDSS

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ABSTRACT: Asthma is a respiratory disease and a significant global health problem. Current methodologies of management have not been individualized, hence low patient outcomes. Furthermore, Asthma is typified by a few symptoms, hence patients' personal decisions may alter formulation adherence. This study suggests the definition and examination of an original CDSS to facilitate individualized asthma care. The CDSS will assess findings in patient data utilizing machine-learning algorithms, allowing the patient for additional suggestions. It will also assist physicians in making individualized decisions regarding the care of patients affected by asthma who are conducive to better adherence. In this study, we will conduct a pilot study enrolling several asthma patients at different points to determine the efficacy of the CDSS. The information will be retrieved through a questionnaire and evaluation of medical records in the pre- and post-periods of CDSS use. The rates of change in interest levels will be compared over this period. The proposed CDSS is expected to enhance patients' asthma control with early intervention and adequate medication regimens. The frequency of exacerbations is expected to decrease by 20–30%. Moreover, the CDSS may also improve the rates of adherence and further the practices by 10–15% and reduce the costs of medication and care. At the same time, the user-friendly system optimally educates patients and provides alerts in a timely manner. Thus, CDSS technology for patient-centered asthma therapy appears promising with the reference.

Keywords: Asthma, CDSS, Genetic, Air Pollutants, Chronic Respiratory

1 INTRODUCTION

Asthma is a complex disorder with chronic airway inflammation, bronchial hyperresponsiveness, wheezing, dyspnea, chest tightness, and coughing [1]. Despite much research, asthma's etiology is unclear, demonstrating its complexity. In asthma, millions of individuals worldwide suffer regardless of age, race etc. [2]. Airway inflammation and hyperresponsiveness produce wheezing, dyspnea, chest tightness, and coughing in this chronic respiratory illness. Although medical improvements have improved asthma prevention and management, its complex etiology demands a thorough understanding of its origins [3]. Genetics drive asthma risk. Genomic research has shown intricate gene-asthma connections [4]. Genetic complexity and environmental factors causing asthma vary by population. Environmental exposures are critical early on. Allergies to pollen, dust mites, and pet dander worsen asthma. Air pollutants including particulate matter and ozone worsen asthma and cause new cases, underscoring the importance of environmental factors [5]. Lifestyle factors including food, exercise, and smoking affect asthma outcomes. Diets high in antioxidants and omega-3 fatty acids may reduce asthma-related inflammation. However, sedentary lifestyles and tobacco smoking greatly increase asthma risk, emphasizing the need for health education and policy changes. [6]. In this paper, a CDSS is proposed (Figure 1) for the treatment and management of Asthma. The CDSS will be categorized into three phases. In the first phase, the initial investigation of Asthma where Electronic Health Records (EHR) are collected and the

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laboratory investigations are put into the CDSS. In the second phase, the important components of CDSS like the Rules Engine, Medical Expert Knowledge Base, Treatment and Management Knowledge Base and CDSS Decision Engine are part of CDSS.

The third phase is the output generated by the CDSS like, whether the patient is suffering from Asthma. If suffering from Asthma, what is the severity level of the disease? It also helps the physician to take efficient treatment and management steps to treat the patient.

2 LITERATURE REVIEW

2.1 *Genetic variants in asthma: Unravelling the complexity*

Previous studies by Smith *et al.* [7] and Johnson *et al.* [8] delved into the genetic underpinnings of asthma susceptibility. Smith's study identified specific gene variants associated with increased asthma risk, emphasizing the role of gene-environment interactions. Johnson's research further explored the heritability of asthma traits, revealing significant familial patterns. Both studies underscore the importance of understanding individual genetic profiles to tailor preventive strategies and personalized treatments for asthma patients.

2.2 *Environmental exposures and asthma severity: A meta-analysis*

In a meta-analysis conducted by Brown *et al.* [9], the impact of environmental factors on asthma severity was systematically reviewed. The study synthesized findings from diverse sources, highlighting the association between high levels of indoor pollutants and increased asthma exacerbations. Additionally, exposure to outdoor allergens, as demonstrated in research by Garcia *et al.* [10], was linked to elevated hospitalization rates among asthma patients. These studies emphasize the urgent need for public health interventions targeting indoor and outdoor air quality to alleviate the asthma burden.

2.3 *Lifestyle choices and asthma management: Insights from longitudinal studies*

Longitudinal studies by Lee *et al.* [11] and Rodriguez *et al.* [12] studied lifestyle and asthma results. Lee found that regular exercise improved asthmatics' lung function as per time. Rodriguez's study focused on dietary patterns, revealing that a Mediterranean diet rich in antioxidants was associated with reduced inflammation and fewer asthma symptoms. These findings advocate for holistic approaches, integrating exercise and dietary interventions into asthma management programs.

2.4 *Psychological stress and asthma exacerbations: Mechanisms and interventions*

Research by Adams *et al.* [13] explored the physiological mechanisms linking chronic stress to asthma exacerbations. Their study elucidated stress-induced inflammatory responses, exacerbating airway hyperresponsiveness. Building on this, interventions studied by Martinez *et al.* demonstrated the efficacy of mindfulness-based stress reduction techniques in reducing asthma-related stress and improving overall quality of life. These studies underscore the importance of integrating psychological support into asthma care protocols.

2.5 *CDSS a boon for physicians*

CDSS development on Chronic Obstructive Pulmonary Disease (COPD) by Sudhir Anakal *et al.* [15] indicates its usefulness in medicine, helping physicians make better and more effective treatment and management choices.

3 MAJOR CAUSES OF ASTHMA

There are a few factors on which the causes the Asthma rely, and some of them have been categorized in this section.

3.1 *Genetic factors*

When it comes to the likelihood of developing asthma, heredity is a major factor. Research has linked asthma to several hereditary variations, including those in genes involved in inflammation, airway remodeling, and immunological responses. Some genetic profiles make people more sensitive to environmental stimuli, which is only one example of how gene-environment interactions play a big role.

3.2 *Environmental factors*

One of the most important factors in the development of asthma is exposure to allergens, pollutants, and respiratory illnesses throughout early childhood. Air pollutants, such as particulate matter and ozone, may worsen or cause the development of asthma, while allergens, such as pollen, dust mites, and pet dander, can cause allergic reactions.

3.3 *Lifestyle factors*

Asthma risk factors include dietary choices, level of physical activity, and smoking status. Sedentary behavior may worsen symptoms, whereas an antioxidant-rich and omega-3 fatty acid-balanced diet help reduce inflammation. Tobacco control is crucial since active and passive smoking greatly raises the risk of asthma.

4 PROPOSED CDSS FOR ASTHMA

Given the severity of asthma, a Clinical Decision Support System [15] is needed for treatment and care. These factors should guide CDSS design:

4.1 *Understanding user needs and requirements*

4.1.1 *Stakeholder analysis*

Healthcare providers, patients, caregivers, and researchers are stakeholders. Conduct surveys and interviews to understand asthma treatment and management requirements and obstacles.

4.1.2 *Requirement gathering*

Record the advice of pulmonologists, allergists, and family physicians. Discover asthma care details, including symptoms, causes, medication history, and co-morbidities.

4.2 *Data collection and integration*

4.2.1 *Data sources*

Collect patient medical history, medicines, allergies, and lifestyle choices. A single database should include EHR, wearable, and patient data.

4.2.2 *Data standardization*

Computer systems are portable and consistent with standard data interface including coding. Communicate medical data with Health Level 7 (HL7).

4.3 *Algorithm development*

4.3.1 *Symptom assessment*

Develop asthma patient-reported symptom analysis approaches. Use the Asthma Control Test to measure asthma symptoms.

4.3.2 *Trigger identification*

Use machine learning algorithms to find contextual and historical triggers. Natural Language Processing clinical note trigger data extraction.

4.3.3 *Medication optimization*

Create systems that can determine the best treatment strategy for each patient and prescribe medications. Consider patient adherence, medicine allergies, and prescription interactions.

4.4 *User interface design*

4.4.1 *User-friendly interface*

Design a user-friendly interface for physicians and patients. Graphs facilitate data interpretation.

4.4.2 *Alerts and notifications*

Warn doctors in real-time with vital patient data. Inform patients of medication reminders, appointments, and trigger warnings.

4.5 *Validation and yesting*

4.5.1 *Clinical validation*

Healthcare provider and patient pilot studies validate CDSS results. Check the system's trigger, symptom, and medication accuracy.

4.5.2 *Usability testing*

Get user feedback on system usability and effectiveness. System improvements should be based on user input and performance ratings.

4.6 *Implementation and deployment*

4.6.1 *Integration with healthcare systems*

Integrating CDSS with healthcare systems and EHRs simplifies data exchange. Ensure platform and device compatibility.

4.6.2 *Training and support*

Train healthcare workers and patients on CDSS usage.

4.7 *Continuous monitoring and improvement*

4.7.1 *Performance monitoring*

Track system performance like response times, accuracy, and user engagement using monitoring tools. Usage trends and user comments might reveal enhancement opportunities.

4.7.2 *Iterative development*

New research, clinical recommendations, and user input should inform CDSS updates. Join healthcare professionals and researchers to adopt asthma management advances.

4.8 *Major components of CDSS*

4.8.1 *Rules engine*

The rule engine's job is to connect the provided data to the engine's processes and initiate those specific actions. The Rule Engine plays a vital role in the proposed CDSS. Python has been used in the design of the Rule Engine.

4.8.2 *Medical expert knowledge base*

This is where the severity of the disease, how the Asthma is diagnosed and the treatment and management strategies for different types like mild, moderate and severe are known.

4.8.3 *CDSS decision engine*

The Machine Learning (ML) algorithms are part of this engine where using the dataset the ML algorithms are trained and tested. ML algorithms part of this CDSS are Random Forest. Decision Tree, Gradient Boosting, Support Vector Machine and Linear Regression.

Flowchart of a decision support system for asthma diagnosis and treatment is shown in Figure 1. It shows how the system collects patient data from various sources, analyzes it, and provides recommendations for treatment.

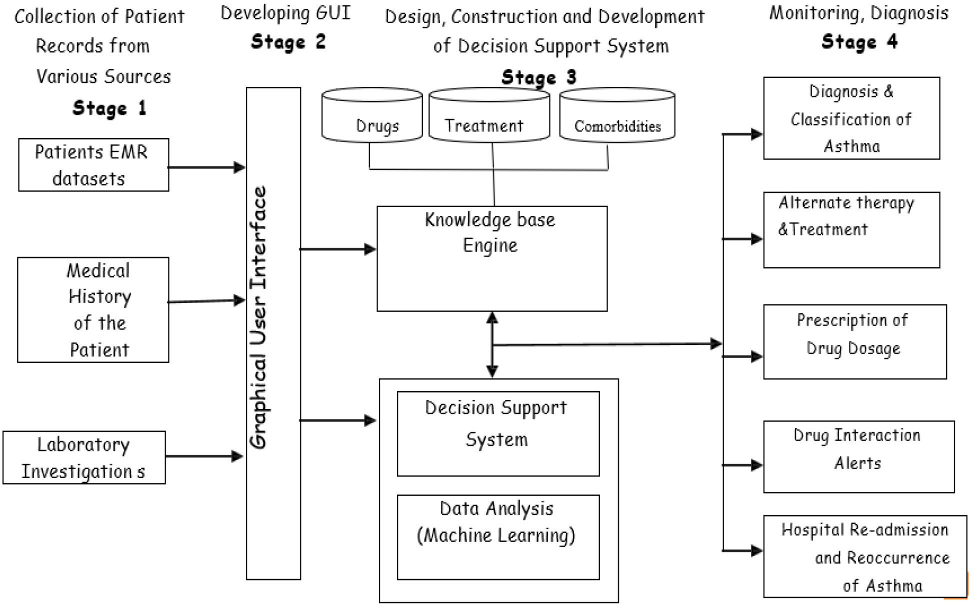
Collection of Patient Records from Various Sources
Stage 1
Patients EMR datasets
Medical History of the Patient
Laboratory Investigation s
Developing GUI
Stage 2
Graphical User Interface
Design, Construction and Development of Decision Support System
Stage 3
Drugs
Treatment
Comorbidities
Knowledge base Engine
Decision Support System
Data Analysis (Machine Learning)
Monitoring, Diagnosis
Stage 4
Diagnosis & Classification of Asthma
Alternate therapy &Treatment
Prescription of Drug Dosage
Drug Interaction Alerts
Hospital Re-admission and Reoccurrence of Asthma

Figure 1. Architecture of the proposed CDSS for asthma.

5 CONCLUSION

Asthma is a multifaceted condition influenced by a combination of genetic, environmental, lifestyle, and psychological factors. A holistic approach to asthma prevention and management must consider these diverse elements. Public health initiatives focusing on reducing environmental pollutants, promoting healthy lifestyles, and addressing genetic susceptibilities are paramount. Additionally, raising awareness about asthma's psychosocial impact is essential for comprehensive patient care. In conclusion, we are designing a CDSS that plays a vital role for physicians and patients in diagnosing, treating, and maintaining Asthma.

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Security-driven data analytics for secure patient monitoring in healthcare application using secure hash algorithm (256)

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ABSTRACT: This work concentrates on applying a security-driven methodology utilizing the Secure Hash Algorithm – 256 (SHA – 256) to improve healthcare data analytics for safe patient monitoring. Materials and Methods: Two different groups have contributed to this project. Group 1 refers to associated with Long Short-term Memory, displaying one level of performance. Group 2 refers to the Secure Hash Algorithm – 256, demonstrating another degree of performance. Result: The healthcare system employs a hybrid cryptography system that includes Paillier and Elgamal to offer high security, scalability, reduced risk of insider attacks, and improved patient privacy with an accuracy rate of 81%. Conclusion: In order to improve patient privacy, mitigate insider threats, and secure wireless medical sensor networks, the proposed healthcare system combines distributed data storage with Elgamal and Paillier cryptosystems.

Keywords: Healthcare Data Analytics, SHA-256, hybrid Cryptography, Patient Privacy

1 INTRODUCTION

The research explores the integration of security-driven data analytics for secure patient monitoring in healthcare applications. It emphasizes the use of the Secure Hash Algorithm – 256 to ensure data integrity and confidentiality. The focus is on securing sensitive patient information, addressing privacy concerns, and complying with healthcare regulations. The goal is to implement robust security measures while conducting data analytics in the healthcare domain. This research provides unique comparative perspectives on electronic prescription systems in eight different nations by examining digital security protocols, system designs, and databases. It points out adoption barriers and emphasizes how e-Prescription systems might enhance global health and patient safety, particularly in the wake of the COVID-19 epidemic [1]. In order to facilitate cross-regional medical data interchange, the study created a blockchain-based PHR architecture that is implemented via AeHIN and guarantees confidentiality and integrity [2]. Since 2009, there has been an increase in reported data breaches involving personal health information, impacting around 27 million people. Theft and loss are the main reasons for these breaches [3]. The article gives a comprehensive assessment of distributed ledger systems, assessing 130 consensus algorithms, creating a new architectural categorization, and providing insights into their distribution, usefulness, evolution, and future prospects [4,5].

2 RELATED WORKS

A literature survey is a thorough examination of existing scholarly works in a specific topic that provides a critical overview of knowledge and informs future study by synthesizing and

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analyzing past years. A developed nutrition recommender system called TanSa categorizes meals by pricing and suggests healthy selections based on user attributes in an effort to boost food security. Tans was created in response to the difficulties of rising food prices and declining food security in Iran [6]. The research offers a thorough analysis of 130 consensus algorithms and distributed ledger technologies, examining their distribution, evolution, and architectural classification across a range of application fields [7,8]. Explore the Cost of a Data Breach Report 2023 to obtain useful insights from the experiences of over 550 businesses, including the causes, factors influencing costs, and practical advice for improving cybersecurity and minimizing losses in the face of prospective breaches [9]. In order to improve data confidentiality and predict trends, time series analysis is being used. This study highlights the digital transformation of the healthcare business by identifying the main causes of data breaches as an increase in hacking attacks and unauthorized internal disclosures [10]. The existing healthcare system relies on IoT and biomedical sensors for patient monitoring, facing challenges such as privacy concerns, sensor reliability issues, and high deployment costs.

3 MATERIALS AND METHODS

The research provides an algorithm that uses wavelet modification to disguise and encrypt one and two-dimensional data, protecting it from detection and hackers. High-security signals and images are obtained by lowering data to sufficient levels for modulation and encrypting with an exponential function, with decryption methods allowing retrieval of original data formats [11].

There are two groups in this novel research of Security-Driven Data Analytics. Group 1 refers to Long Short-Term Memory (LSTM) specialized recurrent neural network architecture designed for processing sequential data, known for its effectiveness in capturing long-term dependencies and intricate patterns based on this it may cause a shortcoming of extensive collection of sensitive health data through IoT devices poses a major privacy concern, increasing the risk of data breaches or unauthorized access. Group 2 refers to the Secure Hash Algorithm – 256 ensures data integrity and authenticity in the proposed system by creating unique hash values for sensitive data. Secure Hash Algorithm – 256 improves security by ensuring data integrity during transmission and storage, thus preventing unauthorized access or change. Integrating SHA protects patient privacy, data integrity, and reduces the danger of illegal access or manipulation.

4 SECURE HASH ALGORITHM – 256

The Secure Hash Algorithm – 256 is a cryptographic hash function widely used for data integrity and security. SHA-256, a specific variant, produces a fixed-size 256-bit hash value Elgamal and Paillier cryptosystems, as well as distributed architecture, are utilized by the suggested healthcare system to improve security and privacy in wireless medical sensor networks, guaranteeing private data transmission and storage. DOCTOR MODULES represents the Elgamal Key Generation: Create cryptographic keys for safe communication, including a public key for encryption and a private key for decryption. View sensor details: Gather detailed information about each sensor node, including status and health data, for network monitoring and control. As shown in the Figure 1. Represents the Uploaded files: Access and decrypt files from sensor nodes while maintaining secrecy, then apply Paillier decryption for statistical analysis. SENSOR NODE MODULE specifies that connect: Create a secure link within the wireless medical sensor network to communicate with nodes and servers. Encrypt and Upload: Divide sensor data, encrypt it using methods such as Elgamal, then upload it securely to specified servers, assuring integrity and secrecy.

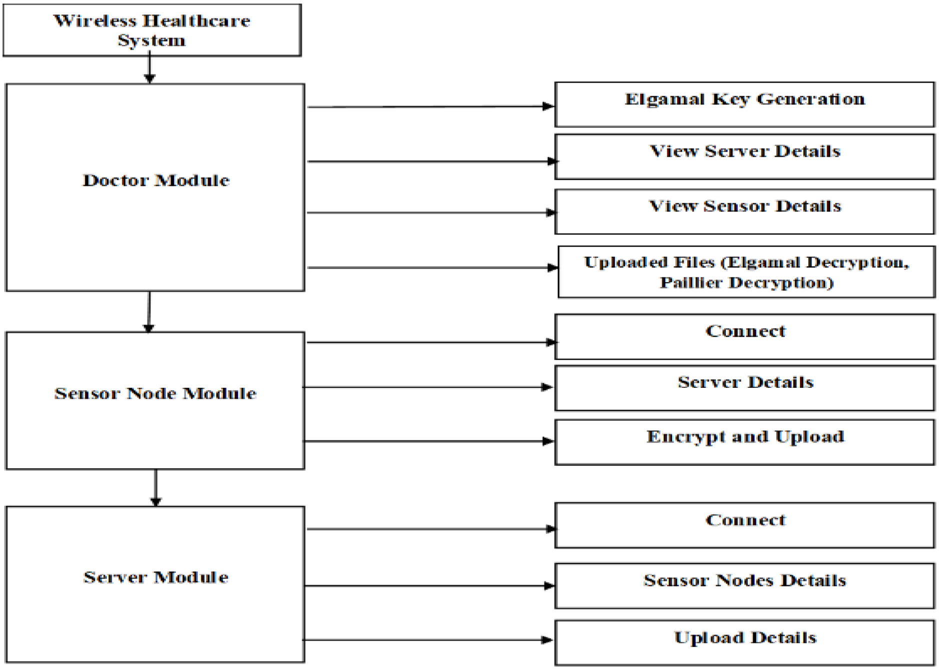


Figure 1. Representation of security-driven data analytics for secure patient monitoring in healthcare application using secure hash algorithm – 256.

5 SECURITY RESULT COMPARISION

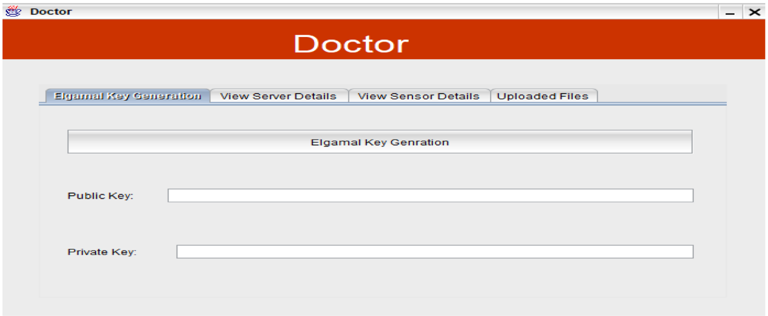
The healthcare system's effectiveness in offering strong security measures and preserving user-friendly functionality is demonstrated by the outcome analysis of its implementation. Table 1 represents the cryptographic technique for improving patient data security in healthcare systems that uses Elgamal and Paillier cryptosystems with distributed storage to reduce insider attack risks. The accuracy measurements demonstrate the usefulness of the proposed cryptographic technique, with Long Short-Term Memory – LSTM achieving a 75% accuracy rate and Secure Hash technique – 256 (Paillier & Elgamal) outperforming it at 81% accuracy.

Table 1. Enhancing patient data security in healthcare systems: A cryptographic approach using Elgamal and Paillier cryptosystems with distributed storage to mitigate insider attack risks.

Algorithm	Accuracy
Long-Short Term Memory	75%
Secure Hash Algorithm – 256	81%

6 RESULTS

The Secure Hash Algorithm – 256 is a cryptographic hash function widely used for data integrity and security. SHA-256, a specific variant, produces a fixed-size 256-bit hash value.

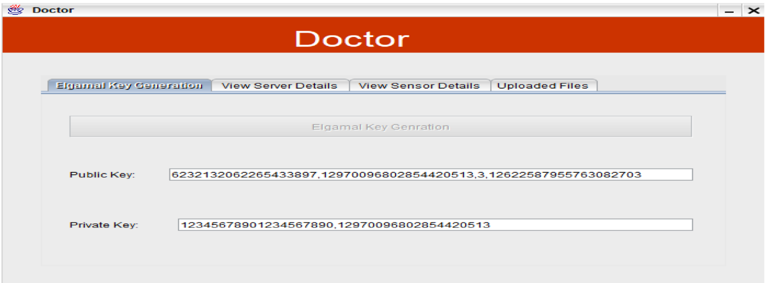


Public Key:

Private Key:

Figure 2. Connect the server and server node to generate the keys.

Connecting the Server and Server Node entails creating a communication channel inside a network architecture. Key generation entails producing cryptographic pairs, which typically include a public key for encryption and a private key for decryption represented in Figure 2. The public key is shared with the Server Node to enable secure communication. Using these keys ensures that data remains confidential and intact during transmission.

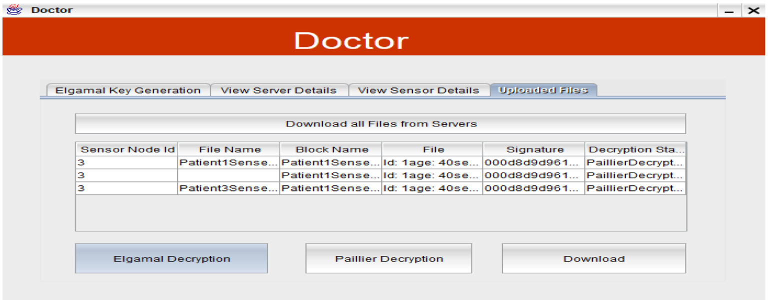


Public Key: 6232132062265433897,12970096802854420513,3,12622587955763082703

Private Key: 12345678901234567890,12970096802854420513

Figure 3. Using Elgamal decryption and Pallier decryption for downloading patient details.

The assertion implies that the "Doctor Module" can securely generate both public and private cryptographic keys, with the public key meant for open exchange in encryption operations and the private key kept secret for decoding. As shown in the Figure 3. represents the procedure is essential to asymmetric cryptography, since it ensures secure communication and data security. This cryptographic technique is critical in ensuring secrecy, integrity, and overall cybersecurity.



Sensor Node Id	File Name	Block Name	File	Signature	Decryption Sta...
3	Patient1Sense...	Patient1Sense...	Id: 1age: 40se...	000d8d9d961...	PaillierDecrypt...
3		Patient1Sense...	Id: 1age: 40se...	000d8d9d961...	PaillierDecrypt...
3	Patient3Sense...	Patient1Sense...	Id: 1age: 40se...	000d8d9d961...	PaillierDecrypt...

Figure 4. Using Elgamal decryption and Pallier decryption for downloading patient details.

ElGamal and Paillier decryption algorithms are used to safely download patient information. As shown in the Figure 4. represents the Paillier, another asymmetric key method intended for secure computation on encrypted data, is also used for encryption and decryption. These cryptographic algorithms work together to maintain the security and confidentiality of sensitive patient data during the download process.

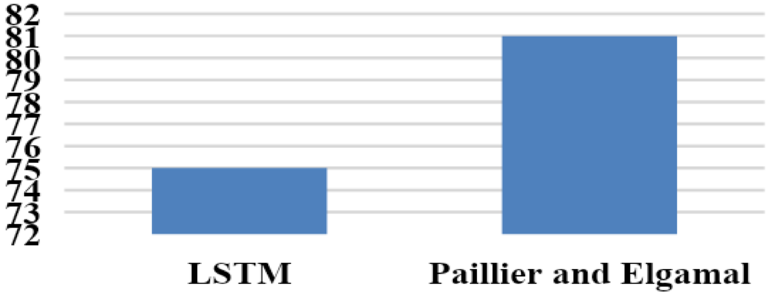


Figure 5. LSTM yields 75% accuracy in sequential data tasks, whereas a hybrid Elgamal-Paillier system improves accuracy by 81%, demonstrating greater data protection.

The accuracy metrics for two different algorithms Long Short-Term Memory (LSTM) and a hybrid cryptographic system combining Elgamal and Paillier are shown in the table. The accuracy of 75%, LSTM proves how well it handles sequential data and is frequently used for applications like natural language processing and time-series prediction. Conversely, employing both the Paillier and Elgamal cryptosystems together results in an 81% improvement in accuracy is represented in Figure 5. This increased accuracy shows that sophisticated encryption approaches have been successfully integrated to protect sensitive data and maintain privacy while enabling efficient statistical analysis.

7 DISCUSSION

A comparison of the two algorithms' accuracy shows that the Secure Hash Algorithm – 256 method outperforms the LSTM algorithm, with 81% accuracy against 75% for the LSTM algorithm. The research focuses on the healthcare industry's digital transformation, increased vulnerability to data breaches, common hacking incidents, and unauthorized disclosures, as well as rising breach frequency, record exposure, and financial losses, using time series analysis to forecast trends and proposing measures to improve data confidentiality [12]. Advanced encryption and distributed data storage are used in the proposed healthcare system to provide secure wireless medical sensor networks that are both practically useful and highly secure, resulting in improved patient care and medical research [13]. The study suggests BlockHR, a blockchain-based architecture, to improve administration, prognosis, and diagnosis of Electronic Health Records (EHRs) systems while guaranteeing data confidentiality and integration [14]. The study addresses privacy issues, unreliable energy markets, and contract optimization for individual EVs while maximizing operators by presenting a contract-based energy blockchain [15]. The Endeavor intends to improve the security of wireless medical sensor networks by dispersing patient data among numerous servers, avoiding insider assaults and protecting patient privacy, resulting in better patient care. Future research might focus on improving system efficiency for larger datasets, integrating blockchain for increased security in wireless medical sensor networks, and honing cryptographic algorithms to enable safe data sharing across healthcare professionals in the suggested system.

8 CONCLUSION

This research presents a novel approach to healthcare by improving security against insider assaults in wireless medical sensor networks and protecting patient privacy. Robust protection is ensured by utilizing distributed data storage with Elgamal and Paillier cryptosystems with an accuracy rate of 81%. In order to improve patient care and healthcare efficiency, a balanced solution that elevates security without compromising usability is made possible by the user-friendly interfaces, seamless networking, and effective data management.

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Design of fabric-based textile antenna for enhanced healthcare monitoring systems

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ABSTRACT: This research introduces a new method for incorporating textile antennas into medical applications. Textile antennas provide a pleasant and adaptable solution to the expanding need for wearable technology in health care. We talk about how to create, assemble, and characterize a textile antenna that is most suited for uses in health monitoring. In terms of flexibility, robustness, and biocompatibility, our suggested antenna performs admirably. We investigate its possibilities in multiple health care settings, including tracking vital signs, remote patient monitoring, and medical diagnostics. Additionally, we go through the difficulties and possibilities associated with implementing textile antennas in health care environments, including integration with current systems, power efficiency, and signal integrity. Overall, our work opens the door for better patient care and monitoring by advancing wearable technologies in the health care industry.

Keywords: Textile Antennas, Wearable Technology, Health Monitoring, Medical Applications

1 INTRODUCTION

Smart textile integration has become apparent as a means of viable route to revolutionize patient care and monitoring in the current era of technology innovation and interconnection. Among the many uses for smart textiles, textile antennas are particularly important because they make wireless communication possible in healthcare environments. Textile antennas provide a smooth way to communicate crucial physiological data in real-time, which improves the efficiency, accuracy, and accessibility of healthcare services in response to the growing demand for wearable health devices, medicine, and remote patient monitoring. Due to concerns with comfort, flexibility, and form factor, antennas have historically been produced using stiff substrates, which has limited their suitability with wearable devices. Nevertheless, these drawbacks have been overcome by the development of textile antennas, which smoothly integrate antennas into textiles and apparel. This breakthrough turns common clothes into advanced medical instruments, creating a wealth of potential for discreet and ongoing health monitoring. The purpose of this conference paper is to investigate textile antenna design, manufacturing, and prospective uses in the medical field. We will explore the special qualities of textile materials that facilitate the integration of antennas, talk about different manufacturing methods, and showcase new developments in antenna design for medical applications. We will also look at the potential and difficulties of using textile antennas in clinical settings, including issues like washability, durability, and signal quality. We hope to highlight in this study the revolutionary effects of textile antennas on patient outcomes and healthcare delivery. By taking use of the confluence of wireless communication and textiles.

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2 OBJECTIVE

The goal is to create, assemble, and evaluate a unique textile antenna for use in medical settings, with the intention of offering dependable and discrete patient condition and vital sign monitoring. In order to develop wearable, cozy, and effective monitoring systems appropriate for medical environments, this study aims to investigate the viability of fusing cutting-edge textile materials with antenna technology. In order to highlight the suggested textile antenna's potential for real-time health monitoring, patient comfort, and clinical application, this research will describe its design approach, manufacturing process, and performance assessment.

3 ANALYSING METHODS

To guarantee the effectiveness of our antenna, we will use a number of approaches for thorough investigation and verification. First, we will create a thorough reference model using the CST Suite program. With the use of this program, we will carefully review important variables like the S-parameter values and the Voltage Standing Wave Ratio (VSWR) to make sure that the antenna's output meets our predetermined standards. This phase guarantees that our antenna satisfies the specified performance criteria and acts as a crucial benchmark to confirm its operation. The manufacturing procedure is the following step after we have used simulation to verify the correctness of our antenna. We will next continue to fabricate a tangible prototype using polyamide fabric and copper yarn. This structure carefully follows the designated design guidelines that were obtained from our verified model. The design obtained from our simulation results will be meticulously stitched onto the polyamide material using the copper yarn.

We then proceed to the performance evaluation of our antenna from a practical standpoint. This means doing an anechoic chamber test on the manufactured prototype. We are able to carefully assess the antenna's gain, radiation pattern, and other relevant features in this regulated setting. An important validation stage is the anechoic chamber test, which lets us compare the actual findings with our simulated expectations. We'll carry out manual testing to confirm the functionality of our antenna after the anechoic chamber test. In order to evaluate elements like signal strength, reception quality, and general functionality under various circumstances, we conduct experiments and observations in the real world. Manual examination yields useful information about how well the antenna performs in actual use and enables us to adjust any differences between simulated and actual outcomes.

To guarantee the dependability and efficiency of our antenna design, our methodology essentially combines a thorough combination of simulation-based analysis, painstaking manufacture, controlled testing in anechoic chambers, and real-world validation. We strive to create an antenna solution that both meets and beyond our predetermined standards by carefully adhering to these stages.

4 DESIGN AND OPTIMIZATION OF THE ANTENNA

The most often used program, CST Microwave Studio, is used to model the proposed microstrip patch textile antenna. Figure 1 shows the architecture of a microstrip patch antenna that operates in the 1GHz–10GHz frequency band. In Table 1, the design specifications are displayed. Leather is the addition used in this project. Table 2 contains a list of the addition specifications. Table 3 displays the optimal value of the planned textile antenna. The addition and patch measurements may be found using the equations (1–5) below [5,6].

$$W = \frac{\mathrm{c}}{2\mathrm{fo}\sqrt{\varepsilon\mathrm{r} + 1/2}} \tag{1}$$

$$\epsilon eff = \frac{\varepsilon r + 1}{2} + \frac{\varepsilon r - 1}{2} x[1 + 2h/w]^{-1/2} \tag{2}$$

$$W = \frac{\mathrm{c}}{2\mathrm{fo}\sqrt{\varepsilon\mathrm{r} + 1/2}} \tag{3}$$

$$\Delta L = 0.412\mathrm{h}\frac{(\varepsilon\mathrm{eff} + 0.3)\left(\frac{\mathrm{w}}{\mathrm{h}} + 0.264\right)}{(\varepsilon\mathrm{eff} - 0.258)\left(\frac{\mathrm{w}}{\mathrm{h}} + 0.8\right)} \tag{3}$$

$$L = L_{eff} - 2\Delta L \tag{4}$$

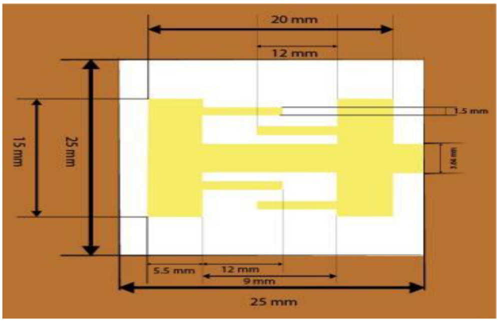


Figure 1. The suggested textile microstrip antenna.

Table 1. Description of the proposed antenna.

Parameter	Value
Operating Frequency	1Ghz to 10Ghz
Return Loss	Less than 10 db
Radiation Pattern	Omnidirectional X-Z plane
Gain	High
Transmission Line	Microstrip Line

Table 2. Electrical properties of polyimade.

Material	Normal
Thickness, h(mm)	0.635
Dielectric Constant, εr	3.5
Loss Tangent	0.006 at 20 GHz.

Table 3. Optimized value of the designed textile antenna.

Parameters list	Dimension (mm)
W	20
L	15
Lf	12.5
Gpf	1.5
Fi	5.5
h	25
Mt	3.64

5 SIMULATION AND FABRICATION RESULTS

Different parameters of the antenna are examined in concern study.

5.1 *S-parameter*

The Figure 2 presents the S11 values of the textile antenna. The calculated outcome of the single band textile antenna using leather as the substrate and the S11 scattering parameter (return loss) is shown in the image. The antenna has a resonance frequency of about 6.477GHz a bandwidth of 0.104033MHz at −10 dB, and a return loss of −34.60 dB, according to the figure.

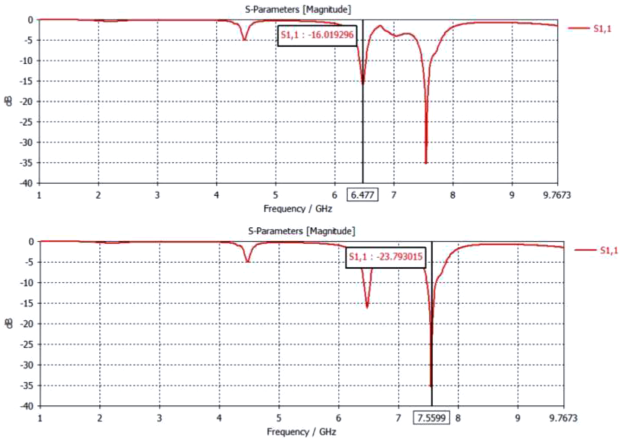


Figure 2. Scattering parameter (return loss) of the designed textile antenna.

5.2 *VSWR*

VSWR is a function of return loss, antenna mismatch has an impact. The Figure 3 shows that at 6.4 GHz, the VSWR of the polymiade textile substrate is less than 2. This suggests that barely ten percent of the electricity gets returned. Figure displays the results of the VSWR simulation. At the 6.4GHz resonance frequency, the VSWR is 1.3811406.

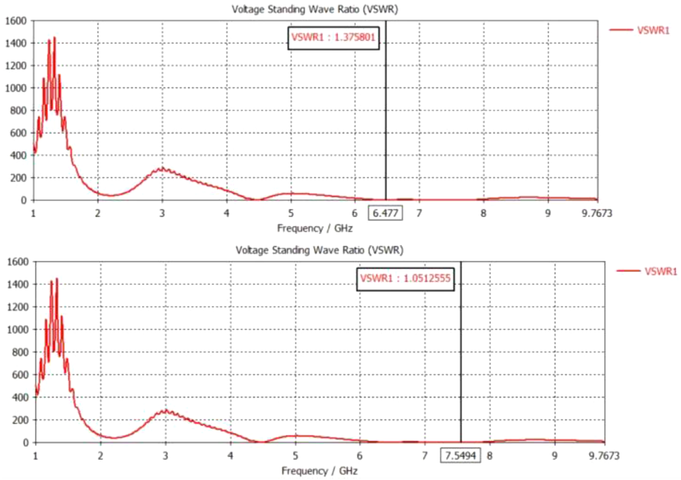
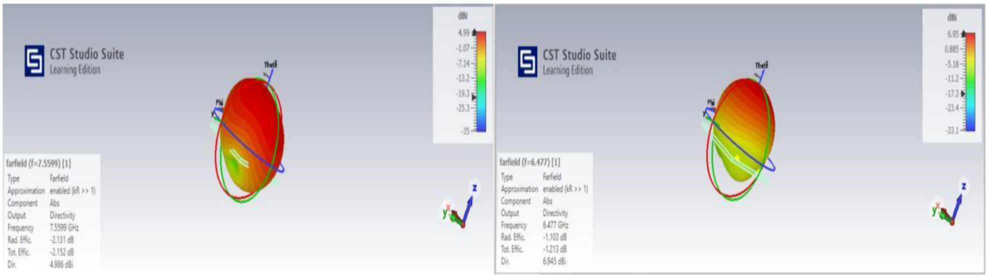


Figure 3. VSWR of the textile antenna.

5.3 *Radiation pattern*

The Radiation pattern of the antenna is plotted in Figure 4.



farfield (f=7.5599) [1]
Type Farfield
Approximation enabled (kR >> 1)
Component Abs
Output Directivity
Frequency 7.5599 GHz
Rad. Effic. -2.131 dB
Tot. Effic. -2.152 dB
Dir. 4.986 dBi

farfield (f=6.477) [1]
Type Farfield
Approximation enabled (kR >> 1)
Component Abs
Output Directivity
Frequency 6.477 GHz
Rad. Effic. -1.103 dB
Tot. Effic. -1.213 dB
Dir. 6.945 dBi

Figure 4. 3-D radiation pattern of the textile antenna.

6 RESULTS AND DISCUSSION

The discussion and the results show that the usage of textile antennas for healthcare applications has been thoroughly examined and verified in the 1 GHz to 10 GHz frequency range. Remarkably, the resonance frequencies of 6.4 GHz and 7.5 GHz in the design's output are inside the permitted range. This achievement is emphasized by the remarkable Voltage Standing Wave Ratio (VSWR) values of 1.375 and 1.051, which demonstrate excellent impedance matching and low signal reflection. This degree of precision in frequency response ensures that the antenna operates effectively within the designated band. This outcome signifies a significant advancement in healthcare technology and offers a practical means for those battling health concerns to monitor their health more often and precisely. The textile antenna the discussion and the results show that the usage of textile antennas for healthcare applications has been thoroughly examined and verified in the 1 GHz to 10 GHz frequency range. Remarkably, the findings hold out hope as a light of innovation, prepared to revolutionize healthcare surveillance by providing trustworthy and accessible techniques for continuous health monitoring.

7 CONCLUSION

In conclusion, the creation of the Textile antenna is a major advancement in the field of health-care applications, especially for the elderly and those battling medical conditions. Through the clever integration of copper yarn into polyamide fabric, this innovative gadget provides a way to continuously track their everyday activities and health. Its flexibility and simplicity of cleaning, together with its easy incorporation into daily wear, significantly enhance the recovery process. Specifically, being able to identify aberrant frequency shifts early on can be critical to acting quickly to prevent any health emergencies. In addition, the use of inexpensive materials like as polyamide guarantees affordability and accessibility for a broad spectrum of people. With continued development and optimization, the Textile antenna has enormous potential for broad implementation and is ready to have a hugely beneficial influence on the health-care sector.

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Specific absorption rate (SAR) in organs of human beings

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ABSTRACT: Analysis of specific absorption rate by the biological tissues: In this analysis, the electric fields induced inside the body due to the penetration of electromagnetic waves inside the body are determined. The penetrated electric field causes absorption of the energy to the tissues. The rate of absorption of energy by unit mass of the biological tissues is specific absorption rate . From the careful analysis of the above chapter, many tissues are absorbed more energy above the International standard safe limit. Hence from the above chapter, we can conclude that high-frequency electromagnetic waves are harmful. The figures in bold indicate specific absorption rates above the International safe standard in the literature tables.

Keywords: Specific absorption rate (SAR), organs, human beings, analysis of SAR

1 INTRODUCTION

The introduction of 5th generation (5G) wireless technology in recent years has caused much debate and concern about its impact on human health. Unlike its predecessors, 5G operates on multiple frequencies and uses millimeter waves (mmWave) to transmit data at unprecedented speeds. While experts tout its transformative ability to improve communication and connection, skeptics have raised concerns about the intervention’s health risks and longterm effects on these radiations. Wireless technologies such as 5G emit electromagnetic fields (EMF) that interfere with biological systems, including the human body. The concern is that 5G higher frequency and shorter range could penetrate deeper into human tissue than previous generations of wireless technology [1,2]. This raises the question of the longterm physical effects of these waves. Research into the health effects of 5G EMF is ongoing and complex. Some studies show potential risks such as cancer risk, brain disease, fertility problems and immune system problems. However, scientific consensus on the severity and nature of these risks has not yet been confirmed. Critics say current security standards are based mostly on research on older wireless technologies and may not adequately take into account the unique features of 5G. They called for more rigorous and comprehensive research to assess the long-term health benefits of 5G technology [3–5].

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2 LITERATURE REVIEW

Large segments of society derive social and economic benefits from the technological development of the modern world, but the health consequences of the spread of uncontrolled developments are difficult to predict and manage without proper support [6]. The rapid progression in the use of various devices that emit electromagnetic fields and the implementation of communication facilities means that EMFs expose children from very early age or, in most cases, from birth [7]. Along with children's developing nervous systems and the more conductive brain tissue need a greater relative RF penetration in comparison to their head. While children will certainly experience a longer lifetime of exposure than adults, some issues suggest that a potential vulnerability to the RF fields developed needs further confirmation. A milder assessment of the existing body of knowledge regarding children's sensitivity to ELF and RF EMFs is appropriate. Very unusual and rare other than under circumstances, health-related to static fields only have an effect at very high levels of field intensity. The effect is where heat is generated at the most potent levels of field intensity. For instance, a child-sized head generates a specific intensity rate compared to an adult head, using a dual-band cell phone. No distinctions are made for both the peak SAR average at 10g between the two adults and between the two child heads. To compare the CS or CL head, there are many fewer peak SAR 10g for the adult head.

2.1 *Exposure to electromagnetic male genitalia*

There is an increasing concern about men's reproductive health's exposure to electromagnetic fields. The linear trend in self-reported radiofrequency field exposure is critical in all age groups, with the infertile rate higher than average. Exposure to radiofrequency radiation does not appear to be related to the number of children [11]. The estimated RF EMF fields were not measured but observed in 149 children and 154 adolescents voluntarily exposed to radiofrequency EMF fields. EEGs were observed to be below the reference level. 7% of the children and 5% of the adolescent showed an abnormal mental behaviour. The complexity of the safety problem and the therapeutic possibilities of all the other EMF used are significant; further studies were also necessary [12].

3 METHODOLOGY

In addition to ultrasound, it will investigate the cold weather absorption of all types of energy by tissue. After a radio frequency attraction field is applied to someone and their body quickly ingests the energy, the specific absorption rate is the rate at which energy is ingested per unit mass. It is shown in light of the office's ingestion watts per photon unit and has watts per photon unit units. SAR is frequently found the middle value of over the whole body or over a little example volume; however, a few standard SARs for more modest example masses are accessible. The provided cost estimate is the highest level estimated inside the portion viable over the predefined or volume or mass [13,14]. The electrical field inside the tissue is commonly used to process SAR for attractive energy, as follows:

Computations for explicit retention energy are frequently determined from the electrical field among the tissue as

$$SAR = \sigma E2/\rho \tag{1}$$

Between them, σ and ρ address the conduction and tissue thickness of the life form, and E is the episode field in the living being. The SAR estimation spreads the region between 100 kHz and 10 GHz (called radio waves). It is normally used to keep up with force consumed by PDAs and tomography. The heap can be intently reliant upon the area and number-crunching of the RF force of the edge. It doesn't cover the legitimate area and number-crunching of the RF power. Cell phone SAR reviews Mobile phone cell Smartphone SAR assessment When deciding the size of the SAR dependent on the cell, the cell phone is set on the contrary side of an individual's head ("SAR Phantom") for staggering correspondence. The SAR charge is estimated in a substance with a strange ingestion charge on the whole head. A battery is generally the reason for the receiving wire of a cell phone, contingent upon the size and capacity. The review can likewise establish the utilization of a device while it is situated on the client's edge and appendages. A few organizations have referenced the greatest SAR level of radiofrequency power communicated through cell phones. In the United States, The association needs unavailable cell phones to have a SAR rating of 1.6 watts or lower, adjusting to the photon unit (W/kg) denouncing one gram of mass [15].

Table 1 shows the specific Absorption Rate (SAR) of the tissues of the human body due to frequency of 3 GHz from 1 to 5 mm inside the body (Calculated 10 m away from 5 G transmission tower).

Table 1. Specific absorption rate (SAR) of the tissues.

Name of tissue	1	2	3	4	5
Blood	**9.691683**	**9.453211**	**9.45321**	**9.453206**	**9.453211**
Blood plasma	**3.375426**	**3.292371**	**3.292371**	**3.29237**	**3.292371**
Blood serum	**3.362241**	**3.279511**	**3.27951**	**3.279509**	**3.279511**
Blood Vessel	**3.094**	**3.084188**	**3.074188**	**3.0689**	**3.0488**
Bone Cancerous	0.903757	0.90102	0.89973	0.89543	0.88932
Bone Cortical	0.173805	0.173115	0.173115	0.173115	0.173115
Bone Marrow (red)	0.056678	0.0566	0.0565	0.0564	0.0552
Bone Marrow (yellow)	0.059512	0.05943	0.05943	0.05943	0.05943
Brain Grey Matter	1.95508	1.936238	1.936238	1.936237	1.936238
Brain White Matter	1.189355	1.180094	1.180095	1.180094	1.180094
Breast Fat	0.306103	0.304786	0.304786	0.304786	0.304786
Breast gland	0.267877	0.266724	0.266724	0.266724	0.266724
Cartilage	**2.87098**	**2.833734**	**2.833734**	**2.833735**	**2.833734**
Cerebellum	**2.288048**	**2.26531**	**2.26531**	**2.265311**	**2.26531**
Cerebro Spinal Fluid	**20.49825**	**19.71891**	**19.71891**	**19.71891**	**19.71891**
Cervix	**5.430608**	**5.322821**	**5.322821**	**5.322816**	**5.322821**
Dura	**4.493647**	**4.409579**	**4.409579**	**4.409579**	**4.409579**
Eye (Aqueous Humour)	**7.554189**	**7.393155**	**7.393154**	**7.393158**	**7.393155**
Eye (Choroid)	**7.151299**	**6.998853**	**6.998852**	**6.998857**	**6.998853**
Eye (Ciliary Body)	**6.888866**	**6.742015**	**6.742014**	**6.742018**	**6.742014**
Eye (Cornea)	**7.070493**	**6.91977**	**6.919769**	**6.919774**	**6.91977**
Eye (Iris)	**6.888866**	**6.742015**	**6.742014**	**6.742018**	**6.742014**
Eye (Sclera)	**7.276031**	**7.120926**	**7.120925**	**7.12093**	**7.120926**
Eye (Vitreous Humor)	**7.471506**	**7.312235**	**7.312234**	**7.312238**	**7.312235**
Eye Lens (Nucleus and cortex)	**6.978498**	**6.829736**	**6.829735**	**6.829739**	**6.829736**
Fat	0.296517	0.29529	0.29529	0.29529	0.29529
Gall Bladder	**8.704635**	**8.482201**	**8.482201**	**8.482205**	**8.482201**
Gall Bladder Bile	**13.51453**	**13.08437**	**13.08437**	**13.08437**	**13.08437**
Heart Lumen	**4.066044**	**4.00483**	**4.00483**	**4.004833**	**4.00483**
Heart Muscle	**3.949441**	**3.889983**	**3.889983**	**3.889985**	**3.889983**
Kidney	**3.722275**	**3.671068**	**3.671068**	**3.671066**	**3.671068**
Kidney (Cortex)	**3.782598**	**3.730561**	**3.730561**	**3.730559**	**3.730561**
Kidney (Medulla)	**3.800714**	**3.748427**	**3.748427**	**3.748426**	**3.748427**
Liver	**2.384311**	**2.357451**	**2.357451**	**2.357449**	**2.357451**
Lung Deflated	**3.810974**	**3.752446**	**3.752447**	**3.752444**	**3.752446**
Lung	**4.617294**	**4.546383**	**4.546383**	**4.54638**	**4.546383**

(*continued*)

Table 1. Continued

Name of tissue	1	2	3	4	5
Lung Inflated	**4.623937**	**4.579184**	**4.579183**	**4.579186**	**4.579184**
Lymph	**6.821862**	**6.678863**	**6.678863**	**6.67886**	**6.678863**
Lymph node	**6.716404**	**6.575615**	**6.575615**	**6.575612**	**6.575615**
Mucous Membrane	**2.762978**	**2.728761**	**2.728761**	**2.728763**	**2.728761**
Muscle	**5.404484**	**5.301584**	**5.301584**	**5.301585**	**5.301584**
Nerve	1.66448	1.648831	1.64883	1.648831	1.648831
Ovary	**3.795071**	**3.737182**	**3.737183**	**3.737182**	**3.737182**
Pancreas	**6.395104**	**6.26105**	**6.26105**	**6.261047**	**6.26105**
Prostate	**6.873247**	**6.733142**	**6.733142**	**6.733145**	**6.733142**
Retina	**7.247938**	**7.093432**	**7.093432**	**7.093436**	**7.093432**
Skin Dry	0.592771	0.590769	0.590769	0.590769	0.590769
Skin Wet	**2.745538**	**2.711537**	**2.711537**	**2.71154**	**2.711537**
Small Intestine	**11.48044**	**11.18922**	**11.18922**	**11.18922**	**11.18922**
Spinal Cord	1.66448	1.648831	1.64883	1.648831	1.648831
Spleen	**2.998147**	**2.964634**	**2.964635**	**2.964632**	**2.964634**
Stomach	**6.509415**	**6.376537**	**6.376537**	**6.376536**	**6.376537**
Tendon	**3.594157**	**3.534068**	**3.534068**	**3.534069**	**3.534068**
Testis	**6.63821**	**6.502896**	**6.502896**	**6.502899**	**6.502896**
Thymus	**6.795189**	**6.652748**	**6.652748**	**6.652745**	**6.652748**
Thyroid	**6.620455**	**6.481678**	**6.481677**	**6.481675**	**6.481678**
Tongue	**4.702056**	**4.622242**	**4.622243**	**4.622245**	**4.622242**
Tooth	0.152119	0.151516	0.151516	0.151516	0.151516
Tooth (Dentine)	0.160747	0.160109	0.160109	0.160109	0.160109
Tooth (Enamel)	0.11211	0.111665	0.111665	0.111665	0.111665
Trachea	**3.949143**	**3.885094**	**3.885094**	**3.885095**	**3.885094**
Uterus	**5.845103**	**5.731486**	**5.731486**	**5.731487**	**5.731486**

Bold figures represent the harmful range of SAR for the health of tissues of human beings

4 RESULT ANALYSIS

The impact of fifth generation (5G) electromagnetic waves on humans has always been a controversial and researched issue. An important feature of 5G waves is that they have more frequencies and shorter wavelengths than previous generations. These tools allow them to access data in a variety of ways, including human tissue. Some scientists worry that this deep penetration could lead to increased absorption of radiation by the body, raising questions about its impact on human health. One known form of avoiding radiation exposure is the generation of electricity in tissue, known as the thermal effect. At high energy levels, such as those used in some industrial or medical applications, this heat can cause tissue damage. While the power of 5G signals is generally lower and is not expected to cause heating in any case, there is concern that local heating may occur in certain situations, especially in millimeter wave technology. In addition to thermal effects, potential nonthermal effects due to electromagnetic fields are also examined. These effects are very mild and may involve biological processes that are not fully understood. Some studies have shown a link between longterm radiation and various health problems, such as cancer risk, nervous system diseases, fertility problems and immunity. However, evidence for these effects is still lacking due to conflicting results from different studies. Researchers have conducted epidemiological studies to investigate the relationship between exposure to electromagnetic fields, including those associated with 5G technology, and adverse outcomes. Some studies have found an association between exposure to EMF and certain health conditions such as brain tumors or childhood leukemia, while others have not shown any clear evidence of increased risk. This complexity makes it difficult to make firm conclusions when examining these effects, including factors such as test accuracy, confounding factors, sampling design. One of the most visible issues related to the electromagnetic fields is the development of safety standards and guidelines which would limit the exposure of humans to harmful outcomes. The task is performed by the global regulatory authorities which are associated with 5G technology, for example. "These guidelines can only be produced on the basis of an assessment of health consciousness and are designed to save people from evil". From other words, the existing criteria should be sufficient to assess whether a certain level of exposure is safe. However, some critics claim that more studies should be conducted and monitoring should be continued. They are convinced that the existing standards do not cover all the peculiarities of 5G technology and its possible long-term impacts. The public perception and the ways of communication have also played a critical role in discussing the health implications of 5G electromagnetic waves. Although false information or speculations have been one of the main sources of people's concerns, the truth is that mass media and internet platforms state their opinions without using the support of scientific findings. Addressing these issues in a truthful way based on scientific knowledge is essential if we are to make decisions on how to go about implementing this new technology.

5 CONCLUSION

After analyzing all the above points, it is concluded that the SAR becomes harmful for the tissues of the whole-body when the SAR is greater than 2 W/kg. According to the data analyzed, if the electromagnetic waves of 3 GHz incident on the body, then, some of the tissues get the energy absorption occur more than the International agencies safe limit. When comparing the data with the safe limit, it is observed that all the tissues of Bone, Brain, Breast, Fat, Nerve, Skin Dry, Spinal Cord, and Tooth from the EMW. The excessive exposure of electromagnetic waves for tissues is blood vessel, Cartilage, Cerebellum, Cerebro Spinal Fluid, Cervix, Dura, Eye, Gall Bladder Heart, Kidney, Lungs Lymph, Mucous Membrane, Muscle, Ovary, Pancreas, Prostate, Retina, Skin, Spleen, Stomach, Tendon, Testis, Thymus, Thyroid, Tongue, Trachea, and Uterus which is harmful and noted that the SAR values higher than safe limit.

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Revolutionizing healthcare: Unveiling the transformative impact of AI and deep learning in the era of intelligent medicine

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ABSTRACT: This research provides a thorough analysis of the current situation of artificial intelligence in healthcare and emphiasizes the major impact of AI on the same. Many large hospitals are using AI systems to assist physicians in the diagnosis of an illness which has led them to experience heightened efficiency and gain insight into more ideas. This study enlightens us about the dual nature of AI applications in the healthcare industry. Despite its rapid advancement, AI technology provides significant opportunities to healthcare workers, helping them provide the best care to the patients. Further in this study, we have provided a detailed analysis of how the application of deep learning and blockchain technology can be utilized in the healthcare sector. We have covered a wide range of topics in our comprehensive study including the algorithm for urinary bladder volume prediction sensors, robotic surgery, radiology, and different scenarios where AI can be used. Furthermore, in the article, we have provided a unique opportunity to give insight into how these applications can bring enhancement to the healthcare system.

Keywords: Artificial Intelligence, Deep Learning, Robotic Surgery, Radiology, Healthcare Systems, Machine Learning, Urinary bladder volume prediction sensor

1 INTRODUCTION

With the rapid advancement and development in artificial intelligence, deep learning, and machine learning, the healthcare sector has revolutionized and has experienced tremendous changes. The structure of the healthcare industry as a whole has seen significant changes in the delivery of patient care, and operational efficiency has seen new heights. Doctors' decision-making skills have been improved due to the AI-enabled technology that is intelligent robots and machine learning. Diagnosis of skin cancer, and breast cancer has been faster and more accurate with the assistance of AI-based diagnostic algorithms. With the help of AI, we can collect data i.e. the medical records from villages, and process them to provide not only the best but also cheap and effective methods in rural areas. Despite these advancements, issues with cybersecurity, privacy, ethics, and data authenticity persist. This study highlights the practical use of AI in patient illness diagnosis, assisting older patients, and illness prevention. It is believed that medical practitioners, educators, hospital staff, and management are expected to gain from these changes and findings.

2 AI AND DEEP LEARNING AN OVERVIEW

As a result of the adoption of advanced techniques in recent years for the identification, treatment, and management of several medical conditions, healthcare sectors have seen significant advancement and have undergone noteworthy transformations. Artificial

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intelligence (AI) and deep learning have been crucial in bringing about this change. The application of deep learning involves multi-layered artificial neural networks, which have proven to be extremely effective at retrieving useful insights from data.

With the incorporation of AI in the medical field, the prediction abilities of medical professionals can be improved resulting in early diagnosis. These transformations can lead to greater precision in the identification of internal issues such as cancer. Evolution of artificial intelligence is shown in Figure 1.

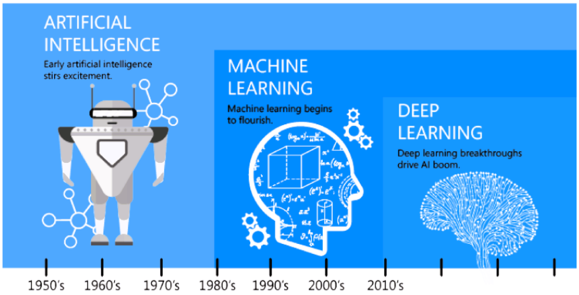
ARTIFICIAL
INTELLIGENCE
Early artificial intelligence stirs excitement.
MACHINE
LEARNING
Machine learning begins to flourish.
DEEP
LEARNING
Deep learning breakthroughs drive AI boom.
1950's
1960's
1970's
1980's
1990's
2000's
2010's

Figure 1. Evolution of artificial intelligence.

3 IMPORTANCE OF DEEP LEARNING AND ARTIFICIAL INTELLIGENCE IN THE HEALTHCARE INDUSTRY

3.1 *Importance of artificial intelligence*

AI is revolutionizing healthcare by improving patient outcomes and diagnostic capabilities, promoting a healthier lifestyle, and enabling accurate disease diagnosis. It helps with medical and business management, ensuring financial growth and effective time management. Explainable AI is crucial for trustworthiness. AI manages a variety of industries, benefits healthcare professionals, and addresses legal viewpoints. It is critical for disease diagnosis, database management, and routine healthcare provision. Given the complexity of healthcare, (Davenport and Kalakota) stress that health professionals must understand the importance of artificial intelligence. AI improves professional job implementation, avoids automation issues, expedites administrative tasks, and fosters patient engagement. AI is essential to the healthcare industry because it facilitates medical decision-making, which raises the standard of care in the end.

3.2 *Importance of deep learning*

Deep learning, when combined with AI technology, has great promise for improving healthcare. It has been integrated into healthcare organizations, resulting in improved quality of life, more accurate decision-making, reduced medical expenses, and better radiological outcomes. It can be used in urgent situations such as cancer diagnosis and pathology, making cancer imaging feasible and closing the gap in healthcare administration. Through deep learning, Amara's law and new technologies can improve technical management and life quality. Integrating deep learning, machine learning, and technical systems is critical in the healthcare sector. According to (Kaur), deep learning and big data are essential for managing healthcare applications. With features like mask encryption, granular access control, monitoring of activity and dynamic data encryption, deep learning advances both architecture and technology. Deep learning plays a key role in transforming healthcare services when combined with AI technology. Its uses in technical paradigms, cancer diagnosis, and other fields improve the standard of healthcare administration, making it, along with AI technology, a vital instrument in the healthcare sector.

4 AI RELEVANCE TO HEALTHCARE

4.1 *Rule-based expert system*

In the late ’90s, expert systems that relied on sets of “if-then” rules are now dominating AI technology and are widely employed in both those subsequent eras for commercial purposes. In the last few decades, they have been extensively used in the healthcare industry for “clinical decision support” and are still in widespread use today. Currently, a set of guidelines is provided by many electronic health record (EHR) providers along with their systems.

4.2 *Physical robots*

For the record, more than 200,000 industrial robots are being installed around the world, and physical robots are now well known. In places like factories and warehouses, robots carry predetermined tasks like shifting, lifting, or assembling objects, as well as delivering supplies to hospitals. In the last few years, robots have learned to work better with humans and can be trained easily by guiding them through a desired task. Soon physical robots may eventually incorporate the same advancements in intelligence that we are seeing in other areas of artificial intelligence.

5 DIAGNOSIS AND TREATMENT APPLICATION

AI applications in healthcare face challenges in integration and implementation, particularly in diagnosis and treatment. However, recent developments in big data and machine learning are transforming treatment and diagnosis procedures. AI models are being developed to help physicians, such as in radiological image analysis and prediction models for population health. Despite challenges in incorporating AI-based recommendations into electronic health record systems, AI has the potential to revolutionize healthcare diagnosis treatment with its advancement.

6 PATIENT ENGAGEMENT AND ADHERENCE APPLICATION

Patient engagement and adherence are two major obstacles that healthcare practitioners must overcome if they are to see favorable results. Medical practitioners construct treatment regimens with great care, but if patients don’t adhere to them, they could not work as intended. Relatively few patients demonstrate high levels of involvement, according to studies, which can result in noncompliance problems. Big data and AI technologies are being used by the healthcare sector to solve this issue.

7 ADMINISTRATIVE APPLICATION

AI must be integrated in order to improve healthcare administration’s efficiency, with a particular emphasis on robotic process automation (RPA). RPA is useful in many areas, including revenue cycle management, clinical documentation, claims processing, and medical record administration. Chatbots are being investigated by healthcare facilities for telemedicine, patient communication, and mental health assistance. The utilization of machine learning in the processing of claims and payments facilitates the accurate identification of coding errors, thereby improving administrative processes. All things considered, artificial intelligence (AI) has the potential to greatly increase productivity and simplify administrative work in the healthcare sector. Significant Application of Machine Learning in Healthcare is shown in Table 1.

Table 1. Significant application of machine learning in healthcare.

Application	Description
Assist psychological difficulties	ML helps people with mental health disorders and the elderly make health-related decisions by organizing schedules and medications. It simplifies the selection process, provides tailored recommendations, and automates clinical judgments, medical billing, and care enhancements.
Radiology	Machine learning improves diagnosis accuracy in radiology. Machine learning (ML) makes machines and devices independence. This is especially useful in robotic surgery, where it automates suturing, evaluates skill, and streamlines workflow to improve patient outcomes.
Medicine discovery	Through enabling contamination detection, efficacy prediction, and personalized therapies, machine learning (ML) transforms drug research and advances patient care and medical research.
Detect minute defects	With the detection of minute abnormalities in patient images, machine learning, and in particular deep learning, improves medical diagnosis. It improves patient outcomes by predicting illness risks and enabling personalized treatments through the use of extensive genetic and health data.
Helps to treat blood cancer	By utilizing artificial neural networks, ML allows for the tracking of worldwide epidemics and improves healthcare interventions for various health issues, ranging from minor ailments to infectious diseases.

8 CHALLENGES IN IMPLEMENTING DEEP LEARNING IN HEALTHCARE

Deep learning's consequences for healthcare come from worries about algorithmic bias and discrimination. Unbalances or biases in datasets can lead to differential diagnoses and treatments that disproportionately affect particular groups. Prioritizing the use of representative datasets is crucial for ensuring accuracy and equity in the provision of healthcare. By resolving these issues, we preserve moral principles when applying deep learning to the healthcare industry and guarantee objective results for a wide variety of patients. The utilization of deep learning and machine learning algorithms in healthcare holds immense potential, but it necessitates a delicate equilibrium between technical proficiency, varied datasets, practitioner competence, accountability, transparency, patient privacy protection, and informed consent. By giving priority to these ethical considerations, we can pave the path for groundbreaking progress in the healthcare industry, ultimately elevating patient outcomes to unprecedented heights.

8.1 *Case study: Bladder volume prediction*

Using machine learning techniques that concentrate on natural bladder sensors, this study suggests a way to track bladder function. A straightforward qualitative method that divides bladder fullness into three stages and a more intricate quantitative method that determines bladder pressure or volume for neurostimulation are both described. Hardware intended for the device used in both techniques to optimize low-power usage. Urinary bladder volume prediction is shown in Figure 2.

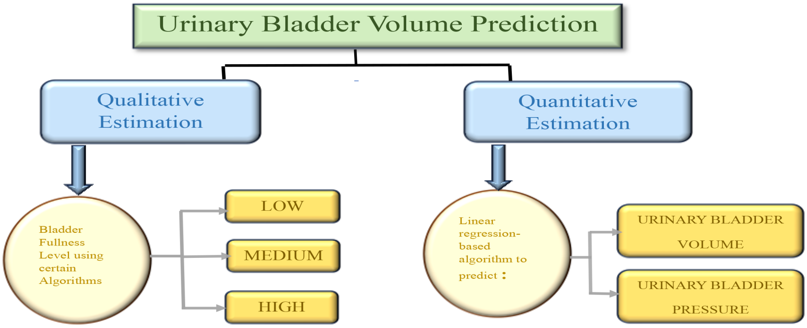
Urinary Bladder Volume Prediction
Qualitative Estimation
Quantitative Estimation
Bladder Fullness Level using certain Algorithms
LOW
MEDIUM
HIGH
Linear regression-based algorithm to predict :
URINARY BLADDER VOLUME
URINARY BLADDER PRESSURE

Figure 2. Urinary bladder volume prediction.

8.2 *The future of AI in healthcare*

Deep learning has a plethora of rapidly developing potential applications in the medical field. By examining large amounts of patient data, finding trends, and forecasting the likelihood of particular diseases, deep learning algorithms can build prediction models. When applied to unstructured data in medical imaging and electronic health records, natural language processing (NLP) provides new insights and enhances patient outcomes. Deep learning enables the creation of chatbots and virtual assistants that improve patient engagement, offer personalized recommendations, and reduce medical expenses. It also helps identify patterns in large datasets for clinical trials and drug development, leading to new pharmacological targets and specialized therapies. Despite this, healthcare organizations face challenges in implementing AI and machine learning for precision medicine.

9 CONCLUSION

The foundation of this paper is deep learning and artificial intelligence (AI), which have opened up numerous doors and facilities for healthcare companies. This essay contributes to the advancement of knowledge on the subject by providing a descriptive definition of deep learning and artificial intelligence. However, it has been critically explained how important this cutting-edge technology is and how it can inspire new ideas in healthcare institutions. Finally, implementing these technologies to change processes can improve the industry’s state of well-being. Medical professionals must acquire knowledge about these technologies to offer advantageous services to all patients.

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AI pharma insights: Transforming the future of healthcare

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ABSTRACT: Artificial Intelligence (AI) is a scientific field of engineering that primarily concentrates on language processing, machine learning, and diverse computing techniques. Artificial Intelligence is extensively employed in the medication design process, which has gained significant importance due to its ability to reduce health risks associated with pre-clinical trials and significantly lower costs. By the time, AI has become more widely used in the healthcare and pharmaceutical industries. This study provides an overview of the various ways that artificial intelligence has been useful and has changed the way that medications are developed, both chemically and physically. Application of artificial intelligence and deep learning has shown to have a number of benefits, including the ability to detect and reduce errors, find, and overcome language barriers through the use of built-in data that facilitates communication with those in need. This paper investigates how artificial intelligence has made notable advancements in the field of pharmaceutical and health sector, transforming areas such as drug recovery, patient data and diagnosis of the disease. It also aims to examine how pharmaceutical industry can take advantage of the new opportunities with AI technology.

Keywords: Artificial intelligence, healthcare, pharmaceutical industry, drug, experiment

1 INTRODUCTION

AI has taken a boon with increasing facilities offered by it and constant upgrades seen through it in range of multiple industrial and that of personal work as well. AI helps in curating a decent life format, in education, and various other aspects of our day to day increasing needs. According to various studies and surveys, it has come into notice that huge data collected and specified with help of AI could profoundly increase the working and positively affect the healthcare system, resulting in a market that generates billions in annual sale performance [1]. In healthcare, hospitality, pharmaceutical, food, fashion etc. With respect to pharmaceutical industry, AI is popularly used in conventional doses forms, in drug designing, drug discovery, analysis and many more important aspects related to programming of any pharmaceutical industry [2]. A two-part method studies were conducted in pharmaceutical and biotechnological industry with AI experts of their respective industry, the study focused on with an outcome of improving a focused use and proper implementation of AI across the entire idea of drug development and keeping in mind of the future aspects seen by use of AI in such an if industry. The survey examined various AI based technological definitions, organizational assessment methods and AI expertise growth with

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that of various partnerships offered in the matter. The experiment came to conclusion with a total of 402 responses that were to be further analyzed [3].

AI has a strong database of collected material that can be used in formulations, for example in formulation and manufacturing of immediate release tablet. The correlation coefficient was used in evaluation of derived materials [3,4]. There is no definite terminology used to explain the word artificial intelligence, it is used as a general term that collectively defines implementation of machine learning, language processing and computing methods etc. AI has transformed the way many industries work, eg: its influence on drug designing and development as initial steps of forming or researching upon, to be defined drug element. Industry experts predict that drugs developed using AI may take a few years to get work started on [4,5]. AI has emerged as a eloquent and vital tool that provides with abundance of knowledge and is prepared with different solutions to various challenges and complexities. AI plays a vital contribution to cost-reduction in R&D by pre-optimizing the processes, it helps to prioritize tasks and predict the PK/PD and toxic properties of drugs [6,7].

Artificial intelligence has appeared as a influential implement that tackle anthropomorphic erudition and delivers accelerate answer to entanglement situations. Impressive or notable improvement in AI automation and machinery knowledge confer a cathartic probability in the discovery and development of drug, establishment and evaluation of pharmaceutical products or remedy [8,9]. AI techniques particularly deep learning, machine learning, different tools and algorithms have helped in fulling the management and processing of drug development, including various other processes. Target therapy, action and time applied towards all of this has been significantly efficient [10,11].

2 OBJECTIVE

The purpose of the study is to be able to explore various aspects of AI that have been significantly helpful in different stages of drug development process and be able to find out consumption of time and resources after the application of artificial intelligence in working with different regions and steps followed in any pharmaceutical or healthcare industry. The aim of this study is to be able to form a compiled database regarding functions and limitations of artificial intelligence when it comes to pharmaceutical industries and its working methodologies.

3 LITERATURE REVIEW

This paper is a systematic analysis of the below mentioned studies done by different researchers in the field of uses of AI in medicine. In the study we have reviewed research papers year wise to make the study more precise and reliable. In 2023, Vora LK *et al.* concluded about how AI has transformed various drug delivery technologies, by enabling personalized and adaptive targeted therapies [7]. Various AI based models have been enforced in pharmacokinetic and dynamic procedures and processes have been efficient and cost-effective. In 2023, Rawat D *et al.* discussed that AI is playing very good role by improving pharmaceutical quality management, health management. AI become very useful by creating new compounds and predicts various aspects such as solubility, design, polarity and reactivity [8]. AI is robotizing drug discovery which rapidly does drug development. AI also very effective in cost reduction and enhance efficacy and patient care. In 2022, Kolluri S *et al.* explained artificial intelligence and machine learning centric and concluded that with use of statistics database methods various transformations have been made in the field of healthcare, especially in R&D [5]. In 2021, patel J *et al.* discussed that AI saves time and there are various AI tools which have been using such as deep learning, ANN, genetic programming. AI has also play important role in clinical trials by finish ADR [10]. According to Paul D *et al.* in 2021, AI plays a vital contribution to cost-reduction in R&D by pre-optimizing the processes, it helps to prioritize tasks and predict the PK/PD and toxic properties of drugs [12]. According to Khanna V *et al.* in 2020, AI plays a good role in marketing improve sells. AI also solves problems like cost and complex problem. AI keeps data from getting lost. [9]. In 2020, Vaishya R *et al.'s* [13] article gives a clear statement regarding how AI had helped during the recent pandemic of COVID-19 while generating various databases that were used during clinical trials as well. (Benevolent AI). With addition in 2019 Mak KK *et al.* explained how AI is overcoming various challenges faced during drug development processes for implementation as various cost-effective challenges are being faced [14].

4 USE OF AI IN DRUG DISCOVERY AND HEALTHCARE

Supervised learning defines as a machine learning type in which algorithm is trained based on labelled database that is formed on output is known. The algorithm learns to elucidate input data and generate output data by examining their connection. Unsupervised learning is based identification pattern as, the algorithm is not provided in this case. This method is applied for exploratory data analysis and is highly useful in drug discovery even when molecular structures are unknown [12]. Different uses of AI in drug discovery has been represented in Figure 1.

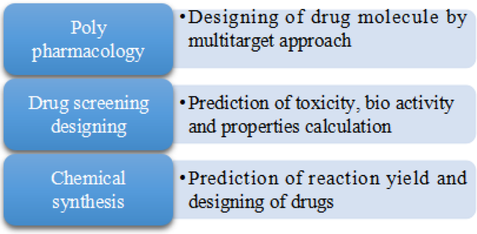
Poly pharmacology
•Designing of drug molecule by multitarget approach
Drug screening designing
•Prediction of toxicity, bio activity and properties calculation
Chemical synthesis
•Prediction of reaction yield and designing of drugs

Figure 1. Representation of AI in drug discovery [12].

Table 1. Different AI models used in pharmaceutical industry [1,2].

Supervised learning	
Machine learning	Deep learning
KNN: classification of compounds, toxicity study etc.	GNNs:modeling for molecular structures etc.
RANDOM FOREST: drug delivery and design, vigilance and drug interaction.	GAN:in ADR prediction and for generation of optimum drug candidate.
SVM: formulation's model relation can be predicted.	RNN: in drug designing, protein content prediction.

Unsupervised learning	
Dimensionally reduction	Clustering
PCA: for facilitating formulations, analysis for quality control etc.	NMF: drug repurposing, drug designing and discovery and chemical analysis.
t-SNE:gene expression pattern	HIERARCHIAL: vigilance, drug discovery

Artificial intelligence has calibre with same level as human beings. The heart to proper functioning of AI in pharmaceutical industry is by obtaining great level of data and investment of pharmaceutical companies in building of this data [13]. The AI algorithm gives authorization to researchers, to be able to scan database from vast range of molecular entities, with a matter of few hours as compared to traditional process that would eventually take up to months or more, depending on the type of information required [14–16]. AI cannot develop an NME (new molecular entity); however, it does help in fastening process in various levels. AI is accountable for generating great interest amongst researchers, practitioners, and scholars as it helps in gaining progress with every work possible [17–19]. AI has helped in upgrading the performance of various parameters of a pharmaceutical industry such as sales, production, marketing and helped in analyzing the progress of business [15,16]. Pharmaceutical companies receive a lot of help from the data generated from various healthcare facilities as well as different companies that help them analyzing the needs of patients depending upon various factors, which also is a faster help generation with assistance from the artificial intelligence. Different AI models used in pharmaceutical industry is shown in Table 1.

Industrial efficacy has increased with the digitization of databases. Various factors that take part in increasing the quality and value of work are as follows: [14,16]. Current resources, Project planning, Data handling, Modelling, Training programs, Error study and Alternative development. This concludes that AI can independently learn and adjust. With help of various experiments performed it has been known that there are two major solutions given by AI, namely analytical solution system in which the AI algorithm allows for a deeper understanding of work and helps with analysis, whereas the second one includes speech, snapshots, videos to find any existing pattern with help of AI and is called recognition technologies [14,17]. AI majorly focuses on: [18–20] Reasoning, Learning, Self-correction, Planning, Automatic decision making and Representation of knowledge. AI powered tools and innovations in drug discovery is shown in Table 2.

Table 2. AI powered tools and innovations in drug discovery [7,8].

AI Model Tools	Summary
DeepChem	This is a kind of library that provides a wide range of models as well as tools for drug discovery,circumscribing deep learning models and algorithms for predicting properties of molecules, deriving new chemical structures and implementing virtual screening.
GraphConv	A deep learning model which is designed to operate on molecular graphs. By the use of structural properties and information, the model has shown a great success in predicting the characteristics of the molecules, such as molecular design, reactivity, polarity, solubility etc.
SMILES Transformer	It is a kind of neural network which is used to predict characteristics of a molecule and also in chemical synthesis. The model is generally used in predicting complex structures and relationships within molecular structures.
AutoDockVina, SchrödingerSuite, Cheminformatics Suite	It does screen for large libraries of compounds for potential drug candidates by using AI algorithms.
AlphaFold, generative adversarial networks	This tool helps in designing new molecules which are helpful and affective against a particular target
ToxCast, Tox21, REACH	This AI tool helps to predict the toxicity of drug patient.

4.1 *AI/machine learning models*

Top 5 most widely used AI tools and models in pharmaceutical industry [7]

- *Generative Adversarial Networks (GANs):* Generation and optimization of novel chemical structures.
- *Recurrent Neural Networks (RNNs)*: These are tools that help in designing tasks which are sequence-based, such as drug development, predicting different structure of different proteins, analyzing genomic data and to design the sequence of peptides.
- *Convolutional Neural Networks (CNNs):* these networks help in pharmacy related image building tasks, predict and anlalyze structure of different molecules and also helps in identifying drug target values.
- *Long Short-Term Memory Networks (LSTMs):* Helps in conducting studies related to pharmacokinetics and pharmacodynamics to predict drug concentration-time profiles and assess the effectiveness of the drug.

- *Deep Q-Networks (DQNs):* A conglomeration of deep learning and reinforcement learning, widely used to optimize the process of drug discovery, to predict the nature and features of compounds and also suggesting potential chemicals and compounds that have high probability of further experimentation.

4.2 *Applications of AI in pharmacology with respect to pharmaceutical industry [18,19]*

Personalized health care, Toxicity prediction, Dose optimization, Nano medicine, Drug discovery, Clinical trials, Drug designing, screening, and monitoring, Project management, Marketing, quality assurance and quality control. AI has guaranteed to influence lives. As seen in the matter of recent pandemics it has been noticed that the world is in dire need for development of therapeutics within unpredictable conditions and in matter of shot time duration [3]. Evolution of AI has remarkably uplifted medical industry very much transforming decision making in medical and healthcare .The influence of AI positively affects all stages a pharmaceutical industry in a very evident way [21–23].

4.3 *Benefits of AI in pharmaceuticals*

Use of AI in a pharmaceutical sector, Enhanced analysis,In hand data, Time management, Decreased failure, Customizable medicine, Easy detection of errors, Faster drug discovery, Quick diagnosis and Enhanced analysis. Artificial intelligence has been an essential component in development of healthcare facilities since a very long time.AI algorithms have shown powerful significance in detection of different types of diseases and medical emergencies. One such known significance has been seen in the development of medical devices, such as, in assistance with diagnosis in various health related issues, which are very well known as X-rays, CT scans, MRI etc. The collective data helps in generating alert for any required needs [24,25] in monitoring for patients' health and dosing needs, for further treatment and obtaining better results. This technique is useful for patient with chronic conditions and regular monitoring, as well as helps to study about patient and the medical condition as well [25,26] In prosthetic devices to be able to control and analyse moment of patient and this part has also helped with machine learning [27] in surgical devices which has significantly helped in the development of surgical robotic systems that contain data for various processes. [24] AI has integrated in various facilities and lead to great advancements, its power to analyse and segregate large data is also quite precise due to which overall healthcare delivery has enhanced. The use of AI is being studied, and it has been significantly working due to the continuous feeding of data within the machine [26,27].

5 CONCLUSION

It has been understood that the AI technology has already been huge success before even completely setting foot in all works of pharmaceutical industry. AI has shown advantage in almost every aspect of working within the pharmaceutical industry and development processes. It has been reviewed and learned that there is yet a long way to go, to be able to use AI to its full potential. Various tools and algorithms, already exist and are still studied to bring about newer changes and modifications. There are quite a few limitations with progress of AI, but those challenges have also been nicely faced with regular studies and development methods. Thanks to artificial intelligence and machine learning, the processes of drug development and various other important process do not consume as much time as from following of traditional methods. However the challenges such as data reliability, reduction of infrastructural cost of implementing AI in healthcare sector, ethical use of AI in drug designing and drug development have to addressed in order to get the most out these AI tools.

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Practicing mindfulness through web-based technologies during Covid-19 scenario

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ABSTRACT: The paper highlights how companies adopted different web-based mindfulness practices to overcome challenges which were faced by the employees during the work from home scenario. This paper also focuses on how employees were motivated through mindfulness activities and started looking out the things normally and increased their level of efficiency which in turn led to increased organizational performance. The research is based on secondary data and is a brief qualitative analysis. The study found that employers practicing mindfulness activities for their employees through web-based technologies during covid-19 pandemic were able to sustain in the market. Employees become highly motivated which resulted in a rise in their performances which led to organizations profit, growth and survival during the pandemic. This study would be very helpful for the organizations to understand how techno-spiritual practices among employees can benefit both individual and organization in their growth.

Keywords: Covid-19 pandemic, Mindfulness practices, Web-based technology, Work life balance, Employee performance

1 INTRODUCTION

Year 2019 was not only tough for the various service sectors like education, hospitality etc. but also led to a disastrous impact on Indian economy (Bayuni 2020) and private sector organizations. This pandemic led to the lockdown in almost all the countries which never happened before in history. In result of this almost all the organizations practiced work from home schedule to continue their business and survive in the competitive market. Organizations started reducing their employees' number and, in some cases, started deducting some percent from the actual salary of the employees. Understanding and experiencing such scenario employees started feeling insecure in their present organizations. This insecurity affected their work performance. They also started facing stress and anxiety which in turn resulted in imbalance in their personal and professional life (Abioro *et al.* 2018). Companies started observing the consecutive downfall in the performance of the employees who were the top performers. To have an option for it, companies started giving online mindfulness practices so that the work-related stress of the employees can be reduced, and they could focus more on their work which could in turn result in bringing back the motivation and job

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performance of the employees. In recent years, research on mindfulness has become a point of interest for academicians, scholars, policy makers, etc. Irrespective of this fact there is still a dearth of empirical research looking into mindfulness at workplace (Ando *et al.* 2011). Motivation drives an employee to achieve personal, professional, and organizational goals with determined outputs (Pancasila *et al.* 2020). Past studies have proved that work motivation is directly proportional to employee performance (Nguyen *et al.* 2020).

Since all the things were made online or web based so organizations started giving online mindfulness practices to the employees which can be coined by the term "Practicing Mindfulness through Web Based Technologies". Further to it mindfulness can be defined as a state of realization or being known or aware about a situation or something or can also be defined as maintaining an awareness of one's thoughts, feelings, sensations, etc. Web based technologies involve making use of the internet or other related technologies to get the work complete. Nowadays it has become important to make use of technologies in every field as technology has touched every aspect of our lives and this is going to continue in future as well. So, companies started motivating their employees by providing them mindfulness practices in an online mode so to keep the morale of the employees high and to make them feel more comfortable with the work stress during pandemic while working from home. This paper highlights how companies adopted different web-based mindfulness practices to overcome challenges which were faced by the employees during the work from home scenario. This paper also focuses on how employees were motivated through mindfulness activities and started looking out the things normally and increased their level of efficiency which in turn led to increased organizational performance.

2 LITERATURE REVIEW

This concept of workplace mindfulness came into picture in 90's but has been followed blindly during Covid-19 when the trend of work from home was followed by every company. The major problem caused by Covid pandemic with respect to organizations was many of the employees of the organizations left their job willingly who were working away from home and on the other hand many companies asked their employees to leave the job as the companies were not able to pay salaries to their employees because of the heavy downfall in the market economy. The starting months of 2021 bought positive hope for companies as the economy was reopening and the companies were trying to come back to the same rhythm but in Online mode only. For this companies formulated and implemented several practices through which not only converting the activities to online mode became easy but also it led to the reduced cost of the organization.

Happiness is universal to all people, and everybody searches for happiness/well-being (Aydin and Khan 2021; Fisher 2014). A healthy atmosphere can only be created through the happiness of employees. Employee Happiness is the state of being content with one's life and career (Dulk *et al.* 2013). Happiness is not gained by external factors like monetary and non-monetary rewards; it comes from the way one chooses to manage their thoughts, actions, and reactions on an everyday basis (Stiglbauer and Batinic 2012). Research reported that the performance of employees depends on the stress level and general well-being of employees which further results in happiness (Rego and Cunha 2008). Job satisfaction directly affects life fulfillment and life satisfaction also has direct impact on job performance (Saari and Judge 2004). Happiness in workplace depends on the quality of life in an organization and is directly proportional to increase in productivity, self-satisfaction, and healthy well-being (Tasnim 2016) To attain a successful position in the market, organizations these days are merely focusing on happiness at the workplace by cultivating self-determination, competence, and psychological well-being among employees.

Previous research suggests that mindfulness practices at work may positively correlate with employee happiness (Drake *et al.* 2008; Hollis-Walker and Colosimo 2011) and mindfulness may improve contentment and wellbeing. Mindfulness at workplace is a practice followed to improve sense of purpose in life to enjoy working environment and is interconnected with the workplace happiness (Crego *et al.* 2021). And a systematic review of 40 studies conducted in University of South Australia proved that mindfulness at workplace is the weapon which improves the employee health and well-being.

3 METHODOLOGY

The research is based on secondary data and is a brief qualitative analysis. We struggled to data with the help of a broad search that included electronic search, bibliography and referencing list of reviewed articles, etc. and from relevant studies. Past research proved that following practices of online mindfulness techniques for employees through web-based technologies helped the employers and employees to achieve personal and organizational goals as shown in Figure 1.

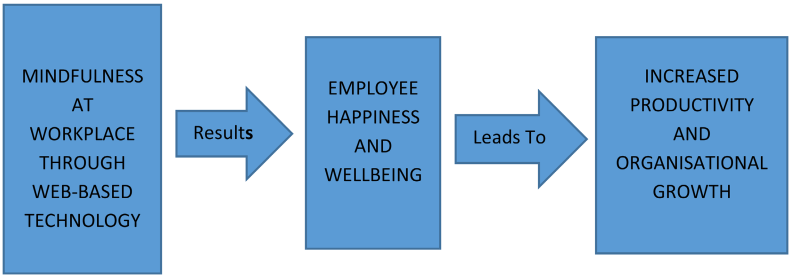
MINDFULNESS AT WORKPLACE THROUGH WEB-BASED TECHNOLOGY
Results
EMPLOYEE HAPPINESS AND WELLBEING
Leads To
INCREASED PRODUCTIVITY AND ORGANISATIONAL GROWTH

Figure 1. Conceptual framework on mindfulness through web-based technologies leading to employee's happiness and organizational productivity.

3.1 *Mindfulness practices for employees through web-based technologies*

- Making the employees aware of the concept of mindfulness and exploring the mindset of employees in an open discussion platform through open communication, informal meetings, and group inquiries via online mode.
- Before starting the work for the day organizations must conduct 10-minute live sessions of meditation through technological sources like MS Teams, WebEx etc. to make the employees more attentive and aware of the present moment. Mindfulness-meditation might increase compassionate behaviors by increased attention to all stimuli (MacLean, *et al.* 2010) and through reduction of self-related affective biases (Hölzel *et al.* 2011; Vago and Silbersweig 2012)
- Any working day in a week preferably weekend should be made a "Happiness Day" where selected practices from different greater good in action websites (https://ggia.berkeley.edu) consisting of kindness, mindful breathing, mental relaxing exercises should be practiced encouraging the employees to keep them mentally and physically sound for their better productivity and well-being.
- SWOC analysis, open group discussion sessions in an online mode should be followed once a month to make the employees understand what their strengths, weaknesses, opportunities, and challenges are. Not only this self-knowing technique should be taught to employees so that they can polish their strengths and overcome their weaknesses and challenges.
- An online safe learning environment must be created to facilitate an understanding of trust, loyalty, commitment etc. among employees and provide a flexible structure that offers space for individual learning to employees. To minimize distraction and focus attention on "The Now" or the task at hand, digital wellness tools should be introduced

to employees. As mindfulness is awareness of the present moment, non-judgmentally (Kabat-Zinn 2003).

- Mindfulness feedback sessions must be conducted on a weekly basis wherein employees must be given free space to express their thoughts and raise their queries regarding their professional challenges faced within the organization. This will increase employees' self-esteem. Given the prior rationale, it is evident that mindfulness predicts self-esteem (Pepping *et al.* 2013; Randal *et al.* 2015)
- Organizations should design creative web-based mindfulness engagement activities to enhance intrinsic motivation and constructive learning exercises for the employees to maintain their work life balance.

4 RESULTS

Synthesizing the literature, the study found that employers practicing mindfulness activities for their employees through web-based technologies during covid-19 pandemic were able to sustain in the market. Employees become highly motivated which resulted in a rise in their performances which led to organizations profit, growth and survival during the pandemic. Organizations practicing mindfulness were able to maintain the well-being of employees which resulted in higher productivity. This study would be very helpful for the organizations to understand how techno-spiritual practices among employees can benefit both individual and organization in their growth.

5 CONCLUSIONS

The world has been affected by the outbreak of the deadly Covid-19 disease; organizations found it difficult to keep their business afloat and were trying to continuously find ways to do so. To sustain in market, companies decided online mode of working as organizational practice for their employees. As mentioned above, the online mode for working became very challenging for the employees in some or another way. Few employees were not able to handle the transmission of work mode from offline to online mode and other employees were not able to meet the set targets of the organizations working from home and were facing work stress and anxiety which resulted in the downfall of their performance and organizations productivity. To overcome this multifaceted situation, organizations adopted mindfulness practices through web-based technologies. To boost the morale of the employees organizations conducted many attention and awareness programs in favor of," Happiness such as online group discussion sessions, SWOC analysis therapy," Happiness day" weekend programs etc. which helped the employees to get encouraged to enhance their performance, reduce their personal and professional stress and stay happy in the present state. This resulted in rising the performance of employees which in turn stemmed to organizations profit, growth and survival during the pandemic.

6 IMPLICATIONS AND SUGGESTIONS

As the paper is purely theoretical, the conceptualization of web-based mindfulness practices leading to employee happiness and organizational productivity should be complemented in empirical research. Future research should focus on the different instruments for measuring mindfulness among employees and should be used to study the before and after changes among employee's behavior and productivity during Covid19. Also, different variables like self-esteem, workplace spirituality, etc. should be studied for framing a related model. Additionally, very few studies till date have been conducted on mindfulness using web-based technologies. Therefore, more qualitative, and quantitative studies can be conducted in the related field.

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An in-depth analysis of gastrointestinal abnormalities using endoscopic imaging and deep learning

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ABSTRACT: Gastroenterologists conduct examinations of abnormal tissue in the gastrointestinal tract, during which they perceive polysegmentation as a complex undertaking. While it provides valuable assistance to gastroenterologists. Polyps, which are abnormal growths of tissue, fundamentally create within the colorectal locale of the gastrointestinal tract. Moreover, it is pre-dominantly found within the mucous layer, which as of now has various bulges of the smaller scale abnormal tissue, altogether opening up the hazard of sickness advancement. Early location of polyps makes a difference repress their movement into cancerous tissue, such as adenomas, which may inevitably create into cancer. The anomalies watched incorporate colored lifted polyps, ordinary cecum, typical pylorus, ordinary z-line, esophagitis, polyps, ulcerative colitis, and colored resection edges. These anomalies are detected using the pre-processed encoder and decoder stages. The quality of colonoscopy images can be significantly enhanced with the implementation of the pre-processing phase. The gastrointestinal tract primarily exhibits abnormalities such as polyps and colitis. The VGG convolutional model provides the highest level of accuracy compared to other current deep learning models. For this research article, we utilized the Kvasir data collection. The Kvasir dataset comprises 4,000 annotated photos of the gastrointestinal tract, categorized into 8 distinct classes. Each class has approximately 500 images. Data sets consist primarily of information regarding the bowel segment of the gastrointestinal tract during colonoscopy. The VGG model achieves superior performance on the Kvasir dataset, with accuracy ranging from a minimum of 87% to a maximum of 97%.

Keywords: Segmentation, VGG CNN (Convolutional Neural Network), R-CNN, ResNet, AlexNet, UNet, Inception Net, Colorectal, Polyps

1 INTRODUCTION

The gastrointestinal system consists of the stomach, huge digestive tract, little digestive system (counting the colon), rectum, and butt, which are the most components of our stomach related tract. The gastrointestinal system is the central organ of the human body's digestive tract, characterized by mucosal enlargements that can range from minor to severe chronic disorders [1]. Polyps are abnormal growths that typically occur beneath the mucous membrane. The colorectal region of the gastrointestinal tract predominantly consists of aberrant tissue known as polyps. Neoplastic and non-neoplastic are the two main categories of polyps that commonly arise in the colorectal area. There are five main kinds of non-neoplastic polyps, including hyperplastic polyps, hamartomatous polyps, and inflammation in the inner lining of tissue [2]. Neoplastic polyps can undergo malignant transformation into cancerous forms over time. The likelihood of this transThe colorectal locale of the gastrointestinal tract transcendently comprises of distorted tissue known as polyps. Neoplastic and non-neoplastic are the two fundamental categories of polyps that commonly emerge within

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the colorectal region formation is determined on the condition and size of the polyp. The colorectal area is the primary site for the development of polyps and other significant gastrointestinal abnormalities, as it comprises the main regions of tissue growth in the innermost layer. This sort of development as a rule happens taking after the change of colorectal cancer, which could be an exceedingly perilous and possibly lethal malady.

The mortality rate for colorectal disorders is only 10%. A colonoscopy surgery is performed to remove the colon after detecting anomalies in the colorectal region, with the aim of reducing mortality rates at an early stage. Several endoscopic methods are available to detect abnormalities in the gastrointestinal system, specifically in the conical focus area. Laser endomicroscopy is a state-of-the-art microscopic method used for biopsy procedures, allowing for the easy collection of pictures at the subcellular level [3,4]. Gastroenterologists do the histopathology technique for the tumor or abnormal tissue growth manually. By detecting anomalies at an early stage, we can limit the death rate caused by aberrant tissue and save lives. Endocytic scopy is a technique employed by endoscopists to capture images of microvascular tissue using the NBI (Narrow Band Imaging) mode. This method allows for the retrieval of high-resolution images up to a scale of 520. We have structured our article in the following manner: the introduction is followed by a section on the linked work conducted. The area presents the materials and strategies utilized for the proposed VGG convolutional arrange. This content examines the recognizable proof, division, and structure of polyps utilizing the VGG demonstrate. The next part presents all of the experimental results and provides a comprehensive commentary. The discussion part also presents the future potential of the research effort in a precise manner.

2 LITERATURE REVIEW

Banik D, Sun S and Sanjana *et al.*, [5–7] have discussed in recent decades, there has been a significant focus on researching automatic disease diagnosis and segmentation, which has shown to be quite intriguing. There are already various appropriate techniques or algorithms available for detecting gastrointestinal anomalies. Over time, several development approaches and algorithms were considered to enhance the texture and color scheme of the polyp. In this research study, we have referred to handcrafted learning characteristics as descriptors. Mori Y *et al.*, [8] discussed about the Convolutional neural networks play a crucial role in the research field, particularly in addressing impending issues. They have proven to be useful for mankind, namely in the domain of computer vision. Polyp and other anomalies are typically detected using colonoscopy photos and movies. CNN transfer learning is mostly utilized for the Inception and ResNets models. The framework for disease identification and segmentation challenges has been developed using Generative Adversarial Networks. An advanced and highly sensitive object detection algorithm, known as YOLO (You Only Look Once), has previously been created for segmentation methods.

Kara *et al.*, [9] proposed a methodology to transfer Learning assesses the degree of specificity and sensitivity in the context of anomalous polyp segmentation. Kronbrog O *et al.*, [10] introduced data-driven methodologies to incorporated segmentation elements that are beneficial for the detection of polyps. Object segmentation employs down sampling and up sampling algorithms to classify pixels. Long has proposed the utilization of a fully convolutional network for the purpose of dissecting anomalous polyps. UNet architectures are a type of convoluted networks.

Mekala, Razman M, Rasheed S *et al.*, [11–13] discussed about the UNets consist of two main pathways: an encoding pathway and a decoding pathway, which are responsible for synthesizing and classifying information. The analysis path discusses the characteristics of deep learning algorithms, while the synthesis component introduces a technique for segmenting features in the learning paradigm. UNet and FCN both utilize an encoder and decoder as essential components in semantic segmentation. The neural network utilizes encoder-decoder convolutional layers, with the encoder extracting important semantic characteristics across different levels.

3 METHODOLOGY

The decoder produces the essential division cover by utilizing the extricated highlights from the encoder and is appeared in Figure 1. Translating gadget the upsampled highlights are combined with the down sampled encoder highlights utilizing skip associations. Convolutional layers create parallel veils as their last yield. A pretrained organize, particularly VGG 16, is utilized for the reason of polyp division errands. Rasheed S *et al.*, [14,15] Remaining systems, such as ResNet50, are utilized for illness location and localization in exchange learning. The residual network employs identity mapping with 3*3 convolutional layers. Identity mapping involves the elimination of deeper neural networks due to the occurrence of vanishing gradients and expanding gradients. The model evaluation in this study utilizes the Kvasir data set.

Table 1 presents a condensed representation of the features utilized by the VGG net model. The VGG model employed the Kvasir dataset for the purpose of detecting anomalies in polyps. Here, we have included photos of all the potential gastrointestinal abnormalities, each exhibited separately.

Table 1. Displays the parameters of the vgg sequential model.

Type of Layering	Output Shaping Values	Paramter Values
VGG 19	None 3,3,512	232134368
Flatten	4609	0
Dense	1034	4178269
Dense_1	484	520824
Dense_2	224	131326
Droup Out	224	0
Dense_3	112	35436
Dense_4	8	1243

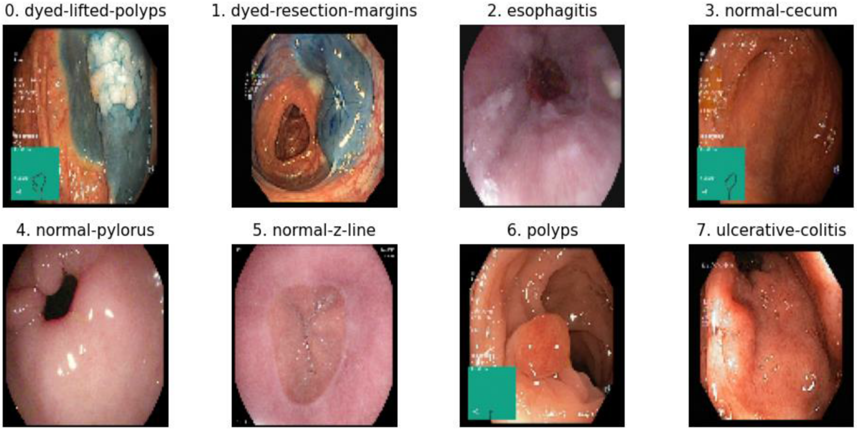


Figure 1. Displays photos of each category of gastrointenstial abnormality.

4 RESULT AND DISCUSSIONS

The KVASIR collection has 4,000 annotated photos of the gastrointestinal tract, categorized into 8 distinct groups representing various anomalies. Each class contains 500 images. Here, we have instantiated classes based on the folder names of the datasets. The Dataset comprises 8 folders, each representing a distinct class. Each folder contains a total of 500 photos. We have allocated 30% of the training set to the validated data set. Information expansion has been performed. Information enlargement could be a strategy utilized to extend the sum of a preparing dataset by creating changed pictures based on the initial datasets. The modified photos are rotated at a random angle between 0 and 360 degrees. We instantiated the Image Data Generator objects to apply augmentation techniques and subsequently applied scaling to the training, testing, and validation datasets. In this section, we provide an explanation of the Kvasir dataset and discuss the performance measures. The Kvasir dataset is described in the data methodology section of the visual geometry group. We conducted training and testing on an Nvidia GTX 1070 GPU configuration for the data portion of the visual geometry group.We utilized a Windows 10 operating system on a machine equipped with a core i5 processor and 8GB of integrated RAM. Colab and Python Spyder IDE are utilized for visualizing and completing the model evaluation. In this section, we have provided the evaluation methodologies, performance outcomes, and analytical presentation of graphs for the Visual Geometry Group model.

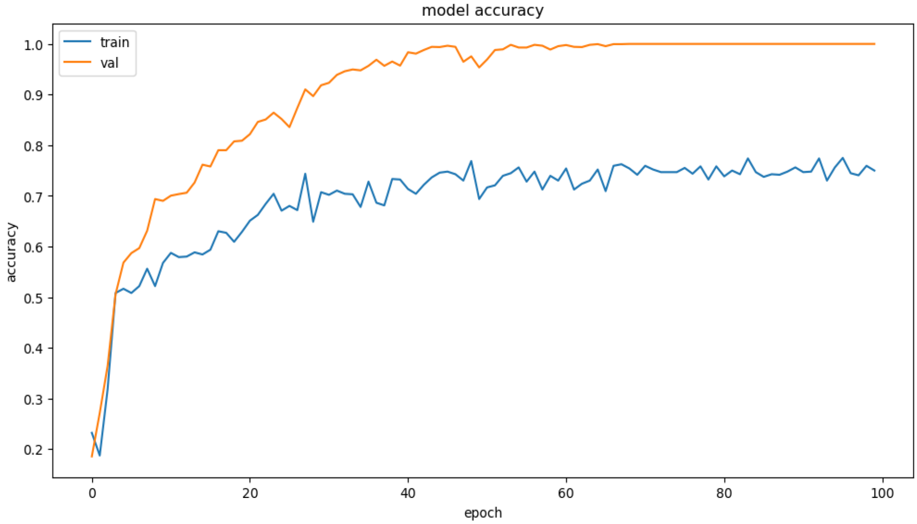


Figure 2. Displays the accuracy of the training and validation dates.

In this area, we have provided the model's performance evaluation procedures and features visualization and shown in Figure 2. We have initialized the VGG 19 model, a pre-trained convolutional neural network, which performed exceptionally well as a transfer learning model. VGG 19 has a significant advantage in that it has undergone pre-training on millions of photos from the ImageNet collection. This pre-trained network can classify photos into thousands of object categories. We have implemented the VGG 19 model by incorporating additional layers to accommodate the 8 classes. A pre-trained network accurately classified a wide range of object categories. We employed a sequential paradigm to construct this dense network. The addition of layers is accomplished by the utilization of batch activation and normalizing techniques. Hyper parameters are flexible parameters that can be utilized to alter the modeling prepare. Hyper parameters play a significant part in deciding the execution of the show. Compilation hyper parameters re connected after the initialization method.

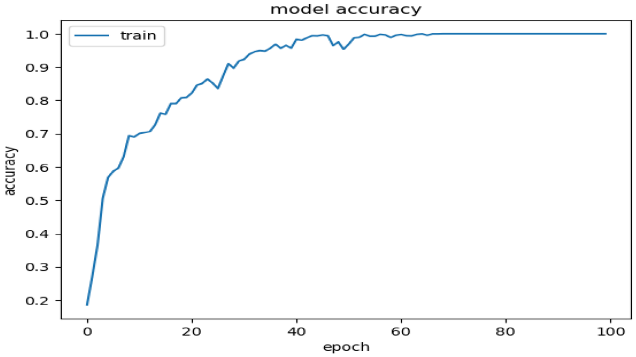
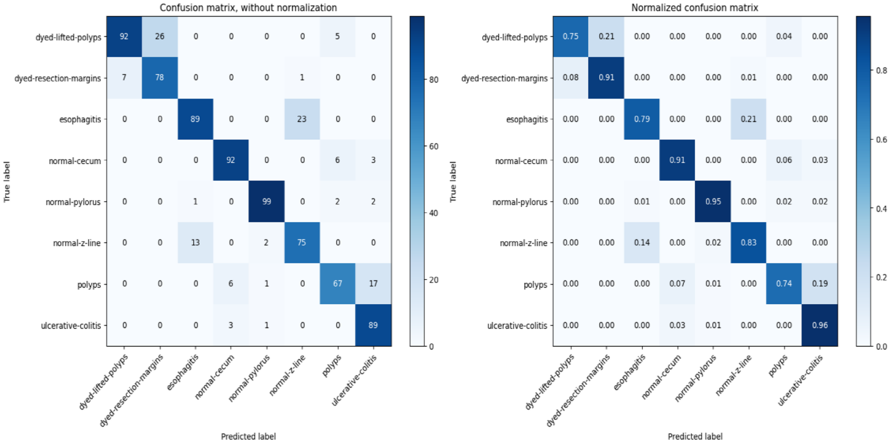


Figure 3. Displays the accuracy of the training data.

In this part, we have generated and displayed both the normalized and unnormalized confusion matrix. We have examined the accurate and inaccurate categorizations of numbers using both normalized and normalized confusion matrices. From Figure 3, it is evident that we have achieved a minimum accuracy of 79% and a maximum accuracy of 97%. We have categorized all the photos into eight primary classes. As shown in Figure 4, we have optimized our training settings to enhance the likelihood of retaining and expanding our operations.



Confusion matrix, without normalization

	dyed-lifted-polyps	dyed-resection-margins	esophagitis	normal-cecum	normal-pylorus	normal-z-line	polyps	ulcerative-colitis
dyed-lifted-polyps	92	26	0	0	0	0	5	0
dyed-resection-margins	7	78	0	0	0	1	0	0
esophagitis	0	0	89	0	0	23	0	0
normal-cecum	0	0	0	92	0	0	6	3
normal-pylorus	0	0	1	0	99	0	2	2
normal-z-line	0	0	13	0	2	75	0	0
polyps	0	0	0	6	1	0	67	17
ulcerative-colitis	0	0	0	3	1	0	0	89

Normalized confusion matrix

	dyed-lifted-polyps	dyed-resection-margins	esophagitis	normal-cecum	normal-pylorus	normal-z-line	polyps	ulcerative-colitis
dyed-lifted-polyps	0.75	0.21	0.00	0.00	0.00	0.00	0.04	0.00
dyed-resection-margins	0.08	0.91	0.00	0.00	0.00	0.01	0.00	0.00
esophagitis	0.00	0.00	0.79	0.00	0.00	0.21	0.00	0.00
normal-cecum	0.00	0.00	0.00	0.91	0.00	0.00	0.06	0.03
normal-pylorus	0.00	0.00	0.01	0.00	0.95	0.00	0.02	0.02
normal-z-line	0.00	0.00	0.14	0.00	0.02	0.83	0.00	0.00
polyps	0.00	0.00	0.00	0.07	0.01	0.00	0.74	0.19
ulcerative-colitis	0.00	0.00	0.00	0.03	0.01	0.00	0.00	0.96

Figure 4. Displays the classification performance using a confusion matrix.

5 CONCLUSION AND FUTURE SCOPE

The implemented/simulated VGG net model achieves superior accuracy in semantic segmentation compared to other convolutional neural network models. VGG utilizes the Kvasir datasets to accurately segment colorectal polyps. The Clahe approach is regularly utilized to intensify the concentrated level of the portioned outlines within the Kvasir information set amid the early arrange of preprocessing. The VGG convolutional neural network is composed of encoding and decoding blocks. In this study, we have constructed five double-stranded DNA (DSB) universal serial bus (USB) blocks. A join arrange is presented in each DSB square of the encoder to realize the finest include mapping for all eight categories. The proposed VGG demonstrate accomplishes a least exactness of 85% and a greatest exactness of 97%. ResNet, Initiation nets, and Alexnets can serve as alternatives to the encoder. The VGG demonstrate can serve as a standard to attain wide targets and illustrate prevalent foundation strategies.

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Technology integration with human resource in organizations during Covid-19

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ABSTRACT: With the changing scenario and the dynamic advancement and growth in technology, especially information technology, all the business or management operations have observed a drastic change. The growth and survival of every company in the market is now highly dependent on the use of Information Technology for carrying out their operations. The transition from manual to automation or advance IT has brought about a Revolution in the strategies that were being implemented in different departments of an organization. With respect to human resources a new concept of EHRM has emerged. This concept of EHRM in the field of HR has led to automated HR process which includes Recruitment, selection, training and development, performance appraisal, compensation management etc. Therefore, it can be said that IT has brought notable changes or has played a very crucial function in shaping it in the way it is in the present scenario.

Keywords: Covid-19 pandemic, E-HRM, Information Technology, Revolution, Performance

1 INTRODUCTION

In a few spans of time starting from late December 2019, severe acute respiratory syndrome Corona virus or Covid-19 started from China and has spread across the world and has led to a drastic transformation of the work throughout the world as by August millions of cases were reported across the world with more than 80000 deaths that were reported globally (Onyeaka *et al.* 2021). It has gained a footing at the beginning of the Year 2020 and has affected millions of people in different ways. For e.g. some people have lost jobs, some have lost their lives; millions more radically have changed the ways in which they work by moving from their offices to their homes. Pandemic has agitated the world, and the subsequent national lockdown disrupted the businesses globally including number of challenges for the organization to retain their employees. Although despite the challenges the organizations have very smartly started creating peaceful environments by proactively and re-actively coping up the changes to stand still in this dynamic and ever-changing environment. Managing HR activities electronically is the solution to the above-mentioned problem (Stone *et al.* 2015). According to the changes in the environment companies are in a need of

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interface which may act as a mediator between the employees and managers and this interface may be called as EHRM because of which the management of human resource in an organization no longer be a matter of stress for the employers. The levels of EHRM differ from organization to organization. In simple words EHRM is the integration of Human resource function and the technology (Galanaki *et al.* 2019) or can also be summed up as performing the HR activities by making use of Internet or web-based technologies.

2 LITERATURE REVIEW

Researchers have made a distinction in the HR services and named them as operations, relational and transformation (Lepak, D. and Snell, S. 1998). Other studies have made similar contributions to it namely Transaction, Traditional and Transformation HRM (Wright, P. and Dyer, L. 2000). Further to it, another study states that to make HR technology effective and worth it must be able to increase the level of service and should facilitate quality work at low cost (Walker, A. J. 2001). Computer based HRM is a complete integrated network of all the HR related data, information, and other tools and services. Technology has evolved recently which has facilitated EHRM to make its contribution in the field of HRM (Kettley P. and Reiley, P. 2003). The development or the chart of growth, however, varies from organization to organization. A researcher has mentioned that EHR is a concept which combines 2 elements i.e. use of Information technology and second the involvement of people i.e. the employees in the organization (Foster *et al.* 2004). Other studies have concluded that there can be no empirical evidence seen with respect to the relationship between EHRM and strategic outcomes (Marler, J. H., and Fisher, S. L. 2013). Another study is focused on providing an insight to the concept of Human resource management and expounds on how HRM has been shifted to EHRM and how it has become unavoidable for the organization and surpass it (Ahmed, A. and Ogalo, H. 2019)

2.1 *Impact of Covid 19 in organizations*

The major problem caused by Covid pandemic with respect to organizations was many of the employees of the organizations left their job willingly who were working away from home and on the other hand many companies asked their employees to leave the job leaving them unemployed (Almeida, F., and Santos, J. D. 2020) as the companies were not able to pay salaries to their employees because of the heavy downfall in the market economy (Akkermans *et al.* 2020) . The starting months of 2021 bought positive hope for companies as the economy was reopening and the companies were trying to come back to the same rhythm but in Online mode only. For this companies formulated and implemented several practices through which not only converting the activities to online mode became easy but also it led to the reduced cost of the organization.

3 BOOMERANG EMPLOYEES THROUGH EHRM

As the organizations were trying to come back with the same zeal in the market therefore, they adopted a simple strategy of bringing back the same employees who were part of the organization through networking and e-recruitment process. This emerging strategy is termed as Boomerang employees (Selvaraj, V., and Venkatakrishnan, S. 2023). The concept of Boomerang has become popular in recent times while its application can be traced back to year 1997 when Steve Jobs, the co-founder of Apple Company joined the company almost after 12 years. This concept of Boomerang employees has not only proven to boost the morale of the employees rather has also led to be one of the cost-effective methods for the organizations as hiring the old employees gives the advantage to the company in terms of cost efficiency and the commitment of the employees towards the organizations because of the familiarity with the organization's mission, policies and processes. In fact, it is also believed that the cost of hiring the boomerang employees is almost two-thirds less than the cost of hiring a new one. So, the companies, through the E-Recruitment process, started repositioning their old employees. Due to Covid-19 pandemic many individuals withdrew their jobs from the companies and returned home to their families to be safe and healthy. This became a problem for the companies who lose their potential employees. As the market was coming back to its position companies started practicing target-based hiring considering the satisfaction and happiness of employees. For this, companies followed several e-recruitment strategies and provided permanent work from home to employees. Companies also decided to operate under hybrid model of online working and bringing their old employees back though hiring the boomerang employees by e-recruitment process.

Table 1. Strategic decisions leads to organizational success.

VARIABLES	OUTCOMES	
Boomerang Employees	Cost Efficiency and Enhanced Commitment	Strategic decisions regarding talent management are interconnected with technological advancements and changing workforce dynamics, influencing organizational resilience and adaptability.
E-Recruitment Strategies	Efficient Talent Acquisition	
Internal Talent Mobility Solutions	Alignment of Employee Aspirations with Organizational Goals	
Leveraging Talent Directories for Mobility	Improved Retention and Recruitment	
Rise of Freelancers	Flexibility and Cost Efficiency	
Use of HR Analytics	Data-Driven Recruitment Decisions	

As shown in Table 1 for recruiting the boomerang employees some changes in the styles were anticipated:

3.1 *Internal talent mobility solutions*

It refers to the internal reallocation of employees within the firm so that their needs, desire and talent are associated with the objectives and goals of the business.

3.2 *Leveraging talent directories for mobility of talent*

Sometimes employers are not able to retain their current employees which may hamper the concept of internal mobility. Therefore, to overcome these challenges organizations have started to hire people through other sources wherein talent directories have come out to be a solution for it as they are responsible for creating a connection between the potential job seekers and potential employers.

3.3 *Rise of freelancers*

One of the most important areas that have seen a drastic impact due to Covid is the increase in the employment of freelancers who can work remotely and can provide support to the organizations. This in turn would lead to cost efficiency and better results as the employees being motivated would be able to give the best of their efforts.

3.4 *Use of HR analytics*

With the advancement in technology and the ever-changing environment, data analytics has been used as one of the ways to understand the trends such as candidate's CV and their social media profiles to boost up the hiring process.

4 PROBLEMS IN EHRM DURING COVID 19

The Outbreak of the Covid has affected the organizations as well as individuals and drastically led to the change in the lives of millions of people resulting in handling the things via electronic means (Gigauri, I. 2020). Some of the problems faced in EHRM during Covid 19 are mentioned below:

4.1 *Managing remote work*

In the pre-Covid scenario less than 40% of companies were following this concept of doing the work remotely. In addition, many industries such as banking, financial companies did not know about the concept but after the outbreak of Covid 19 every company is rushing towards it, and this has become difficult for the HR professionals to manage the real time update and to handle the situations and provide support to the organizations.

4.2 *Employee communication*

This was another major problem faced during the Covid 19 scenario as there was no physical contact with the employees and it became a challenge for the employers to understand the mental state of the employees by merely communication with them through online mode and this resulted in increased gap among the employer and employee when the employees were asked to rejoin the workspaces.

4.3 *Employee engagement*

The main goal of every organization is to increase its productivity and it can be done only when employees are fully engaged and give their 100% performance. However, it becomes difficult for the organization to engage and keep track of the employees who work remotely because of lack of sessions/meetings with them (Iqbal *et al.* 2019).

4.4 *Mental health and well-being*

The rapid change in work culture from office to remote has changed the story. Though stress, anxiety is nothing new which is seen in the remote working also but now it has become difficult for the organizations to handle the employee stress working from remote as in work from office it is easy to understand and sense their situation and motivate them to give their best.

5 RESULTS

By having a thorough look at all the various factors mentioned through extensive reviews. The trends followed in the organizations are that the organizations have become more strategic in terms of management of human resource during covid 19. IT has brought notable changes or has played a very crucial function in shaping it in the way it is in the present scenario and to remain competitive in a changing business landscape. They are leveraging internal and external talent sources, embracing flexible work arrangements along with a blended Information Technology adaptation to improve their talent acquisition and retention strategies.

6 CONCLUSION

From the above paper it can be concluded that Boomeranging through E-recruitment process has emerged as a widely accepted concept in most of the organizations for growth and survival in the market during the pandemic and it has changed the complete scenario of HRM during Covid 19. In addition to this, with the implementation of cloud-based technology most of the companies have started following the E-HRM practices to manage their human resources in an effective and efficient manner. As a result of it, the story of human resource management has completely changed. Though the environment is in positive hope of getting things normalized but then also EHRM has evolved as an advance strategic move for the companies to grow and must be implemented at all the levels to make the organizations grow in the long run and to help the organizations take up the challenging task in the challenging environment (Giurge, L. M. and Bohns, V. K. 2020).

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Impact of artificial intelligence in enhancing pharmacovigilance

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ABSTRACT: The field of pharmacovigilance is the practice of monitoring and assessing the safety of drugs and medical devices. The major barriers to reporting adverse drug reactions (ADR) in India include lack of training in ADR identification, clinician attitudes concerning reporting, difficulties setting up reporting systems in hospitals, and a lack of understanding and awareness among health professionals. About 90% of ADRs go unreported. AI can increase ADR reporting rate by mining unreported ADEs documented in medical papers and Electronic Health Record. AI is being utilized to automate ICSR and improve pharmacovigilance by efficiently retrieving medical and clinical data from free text to extract information from adverse event reports and save it in a patient safety database with improved accuracy. AI technologies play a crucial role in pharmacovigilance by automating the examination of large volumes of data, such as adverse event reports and medical literature, to identify potential safety signals. By leveraging ML and NLP, pharmacovigilance professionals can efficiently detect and assess drug safety concerns, ultimately improving patient safety and regulatory compliance. AI has occurred as a favorable technique for improving pharmacovigilance processes. This systematic review will look at the role of AI in pharmacovigilance, its advantages over traditional methods, and the limitations and obstacles of integrating AI.

Keywords: Pharmacovigilance, Drug safety, Artificial Intelligence

1 INTRODUCTION

Artificial intelligence (AI) is changing the landscape of pharmacovigilance practices. Pharmacovigilance is an important aspect of drug safety surveillance throughout the process of drug development to post marketing. It involves collecting and analyzing data on adverse drug reactions and implementing strategies to minimize risks and improve patient safety. With the rapid advancements in medical technology and the introduction of novel drugs, pharmacovigilance continues to advance to encounter the challenges of ensuring drug safety in an ever-changing healthcare landscape. The Uppsala Monitoring Center (UMC) currently oversees a global network of pharmacovigilance centers [1]. "Pharmacovigilance, as defined by the World Health Organization (WHO), encompasses the scientific endeavors and actions involved in identifying, evaluating, comprehending, and mitigating adverse drug effects or any potential drug-related issues." McCarthy defines artificial intelligence as "the discipline and practice of developing intelligent machines, particularly sophisticated computer

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programs." By utilizing AI in pharmacovigilance, the process of identifying and analyzing adverse drug reactions can be automated, reducing the need for manual intervention. This not only increases efficiency but also allows for real-time observation and early detection of potential safety concerns.

Additionally, AI can assist in streamlining the reporting and documentation processes, ensuring accurate and comprehensive data collection for regulatory purposes [2]. Machine Learning (ML) and Natural Language Processing (NLP) are key domains of artificial intelligence (AI) extensively applied in pharmacovigilance. The US Food and Drug Administration (USFDA) characterizes ML as "a method employed to develop and educate software algorithms to derive insights and take actions based on data." Similarly, NLP is described as "the utilization of computational methods for analyzing and generating natural language and speech [3,4]. Between 2008 and 2017, the FDA granted approval to 321 new medications, while the FDA Adverse Event Reporting System (FAERS) documented over 10 million adverse event (AE) reports during this timeframe. Among these reports, 5.8 million were classified as serious, and 1.1 million were linked to fatal outcomes. Handling such extensive datasets using conventional methods proves to be challenging [5]. In a systematic review, use of AI in PV was described which highlighted use of machine learning to predict side effects, identify ADRs, drug interactions, high risk populations and generate automated safety signals using ML. Processes for pharmacovigilance can be improved by automation and machine learning models, which also offer a more effective method of studying safety-related data [6].

This review aims to discern the role of AI in pharmacovigilance, its advantages over traditional methods, and the limitations and challenges associated with integrating AI. In this paper, we will analyze the current research on the use of AI in pharmacovigilance and examine its potential to improve patient safety and healthcare outcomes. We have also listed some of the softwares used in pharmacovigilance by different pharmaceutical industry.

2 LITERATURE SURVEY

2.1 *ADR reporting and AI*

The major barriers to reporting ADRs in India are a lack of training in ADR identification, clinician attitudes toward reporting, problems setting up reporting systems in hospitals, and a lack of knowledge and awareness among health professionals [7]. Not all the Adverse Drug Reactions (ADR) are detected by clinical trials; this is where pharmacovigilance is important to ensure patient safety. It is estimated in a systematic review that about 90% of ADRs go unreported. Most of the ADR reporting is done through Spontaneous Reporting Systems which involves Marketing Authorization Holders and Health Professionals [8].

AI assists in determining the reliability of the ADR reporting form without the need for human interaction, resulting in improved data accuracy. The greatest difficulty in spontaneous reporting is the repetition of reporting, which has been greatly reduced with the use of AI in PV. As a result, PV centers of the national level contribute in worldwide drug monitoring programs through the use of AI in practice. Use of AI in pharmacovigilance not only makes collecting and managing the vast amount of ADR data collected globally but also makes reporting easier and economic. AI can be used to increase ADR reporting rate by mining unreported ADEs documented in the medical papers and Electronic Health Record (EHR). PV information can also be collected through social media like Facebook and Twitter which can be used as complementary source of information after processing the data into structured information [9]. A systematic review reported that people used forums and websites like drugs.com and social media like twitter, to report ADRs related to HIV, depression and Cancer treatments. The ADRs reported were converted into structure texts using AI tools [10].

In India, ICSRs are mandatorily submitted to NCC-PvPI and CDSCO by MAHs. From NCC-PvPI the reports are submitted to WHO-UMC and stored in Vigibase software.

Currently, 179 monitoring facilities for adverse drug reactions (ADRs) submit ADRs to NCC. India now contributes 3% to the worldwide safety database, and its completeness rating is 0.93 out of 1. Reporting is being promoted continually by health professionals through NCC website, PvPI application, social media, website, newsletters and journals [11].

2.2 *ICSR processing*

ICSR are documents or forms containing patient information about reporter, adverse events, suspected medicinal products, reported by medical health professionals to regulatory agencies useful to detect signals and ADRs [4,12]. ICSR is processed by AI in two ways [13] AI for decision-making: ICSRs are generally incomplete and of inferior quality. thus, AI could serve a crucial part in creating unlisted or individual random AEs, drug classifiers, correlation, and furthermore. Insert structured and unstructured information: For reading the case, insert material via XML, DOCX, Image, and PDF. To extract ICSR information in a regulatory-compliant manner, NLP and ML are applied.

The four steps of case processing are intake, evaluation, follow-up, and distribution. Intake entails determining the four aspects of an ICSR, as well as any pertinent information. Other processes include determining regulatory categories, the severity of adverse reactions, the predictability, and the possibility of a causal relationship. Report follow-up is carried out in order to acquire missing information and send the report to regulators [4]. AI is being utilized to automate ICSR and Improve pharmacovigilance (PV) by efficiently retrieving medical and clinical data from free text to extract information from adverse event reports and save it in a patient safety database for further processing with improved speed, accuracy and decrease cost [14]. A new Deloitte survey of global biopharmaceutical companies reveal a growing trend in PV procedures. Companies are working to improve productivity and cut costs. According to the report, 90 percent of respondents said their major goal was to lower case processing expenses [15].

2.3 *ADR detection using AI*

Social media is being used these days to gather safety information about drugs and is also thought to generate new ADR signals as it may have different types of information than present in her and spontaneous safety reports. However a study directed by Dr. Ola Caster *et al.* concluded that social media do not contribute significantly to the pharmacovigilance [16]. AI is being used to detect ADRs, drug interactions and detect safety signals. Five different methods are used to detect ADRs which are statistical analyses (disproportionality analysis, descriptive analysis, computational analysis, cohort study), which have been used for detecting side effects of risperidone, while text mining, NLP, ML and deep learning have been used to detect ADR from social media, EHR and bibliographic databases [17]. AI can identify patient-level clinical characteristics linked with ADEs and automate targeted follow-up. It can detect hidden trends and missing patients, as well as determine appropriate screening intervals and reduce duplicate counting for more accurate estimations. This technique can aid in the identification and management of ADEs.

2.4 *Application of various softwares*

Various software and platforms play critical roles in pharmacovigilance, facilitating tasks ranging from adverse event categorization to signal detection and regulatory reporting. MEDRA is instrumental in categorizing adverse effect cases within pharmacovigilance databases, streamlining searches for easier access. Eudravigilance serves as a comprehensive database for collecting and evaluating suspected adverse drug reactions (ADRs), aiding in their analysis and management. IDMP ensures the unique identification of medicinal products, enhancing traceability and accuracy in reporting. WIPRO Smartance and Oracle Argus Safety are pivotal in processing Individual Case Safety Reports (ICSRs) and conducting medical reviews, crucial steps in pharmacovigilance workflows. Signal detection and management are facilitated by platforms like IQVIA Vigilance Platform, WebVDME, and VigiLyze, enhancing the ability to identify potential safety concerns promptly. ARISg and repClinical streamline adverse event reporting and regulatory compliance, automating the generation of submission-ready reports. ClinTrace and Vigibase contribute to adverse event reporting and database management, while Vigilanz Dynamic Monitoring System aids in hospital management and clinical surveillance. MedWatch serves as a platform for establishing safety reporting initiatives accessible to healthcare professionals and consumers alike, disseminating safety alerts. VigiFlow and PvNET play crucial roles in managing adverse event reports and ADR data, respectively, contributing to efficient pharmacovigilance operations. Additionally, XEVMPD serves as the European Medicines Agency's database for tracking pharmaceutical product data, supporting drug safety monitoring, and tracking efforts. Overall, these software solutions collectively enhance pharmacovigilance efforts, ensuring the safety and efficacy of pharmaceutical products through robust monitoring, analysis, and reporting mechanisms.

3 CHALLENGES AND LIMITATIONS

The assimilation of AI in pharmacovigilance is not deprived of limitations and challenges. One foremost challenge is successfully applying AI technologies and strategies to the PV industry. Furthermore, transparency and interpretability are crucial in pharmacovigilance, which makes it difficult to develop AI models that are both precise and interpretable. AI systems used in pharmacovigilance must adhere to stringent regulatory requirements, including documentation, auditability and validation of AI systems to meet regulatory standards, which can pose noteworthy challenges. AI-powered tools software and websites listed in table-1 and AI models for optimizing pharmacovigilance processes are increasingly being employed in the PV industry.

The International Council for Harmonisation published MedDRA (Medical Dictionary for Regulatory Activities), a standard vocabulary for medicine that is primarily used to code adverse effect cases in clinical study reports and pharmacovigilance databases. It also makes searching these databases easier. However, MedDRA's complexity and inadequately assessed performance leave it open to prejudice, manipulation, and misunderstandings. This is especially true for the statistics on adverse effects found in clinical study reports and clinical trials. The real frequency of adverse effects may be underestimated if they are reported in fragmented ways across many parameters. Innovative AI algorithms, for instance deep neural networks, are often considered as "black boxes" because it is tough to apprehend the reasoning behind the forecasts of AI models. This is especially concerning in PV, as the consequences of AI-driven judgements can be life-critical. To ensure compliance with guidelines set by regulatory agencies is a complex and resource-intensive process, making it difficult to implement AI models in pharmacovigilance [15]. Therefore, while there are significant advantages to the incorporation of AI technologies in pharmacovigilance, significant challenges remain in ensuring the safe and effective implementation of these technologies.

4 CONCLUSIONS

The incorporation of AI technologies in pharmacovigilance practices has substantial potential to enhance patient care, advance drug safety monitoring, and meet regulatory requirements. The primary challenge in spontaneous reporting lies in the repetitive nature of reporting, a hurdle that has significantly diminished with the integration of AI in pharmacovigilance. AI aids in assessing the reliability of ADR reports autonomously, leading to enhanced data precision without human intervention. Despite the promising advantages of

AI in pharmacovigilance, considerable obstacles persist in guaranteeing the secure and efficient deployment of these technologies. Future research should focus on addressing these challenges and identifying potential biases or limitations in AI-powered pharmacovigilance. Overall, the integration of AI in pharmacovigilance represents a new era of intelligent pharmacovigilance, maximizing the predictive potential of data and expanding monitoring surveillance, ultimately contributing to the improvement of patient outcomes.

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Blockchain revolution in healthcare: A comprehensive survey

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ABSTRACT: The healthcare industry is about to undergo a profound transformation due to the potential for blockchain technology to drastically change its fundamental policies and practices. This comprehensive survey paper, titled “Blockchain Revolution in Healthcare,” examines the numerous ways that blockchain technology is impacting healthcare systems and services. In this paper, the key components of blockchain—smart contracts, decentralized ledgers, and cryptographic security—as well as their applications to healthcare are discussed. First section of the research paper gives an overview of the challenges and inefficiencies that the healthcare sector is currently dealing with, with a focus on issues related to interoperability, patient privacy, and data security. The way in which blockchain technology can help with safe, open, and immutable data management and sharing is explained in the following section.

Keywords: Blockchain technology, Healthcare industry, Transformation, Interoperability & Data security

1 INTRODUCTION

The healthcare industry, one of the significant pillars of modern society, is undergoing a radical makeover that will probably change its fundamental practices and organizational structures. At the core of this revolution is blockchain technology, an invention that has the ability to solve prevailing problems and usher in a new era of healthcare(Hölbl).

In a world where data security, interoperability, and patient privacy are now top concerns, blockchain technology exhibits promise. With its promise of safe, open, and unbreakable data sharing and management, it holds the key to solving issues that have long plagued healthcare systems.With the fitting title “Blockchain Revolution in Healthcare,” this extensive survey paper sets out to investigate the various ways that blockchain technology may affect healthcare services and systems. We will explore the fundamental elements of blockchain technology smart contracts, decentralized ledgers, and cryptographic security together, revealing their uses in the medical field. We will discuss the current issues facing healthcare, such as interoperability and data security, and show how blockchain technology can help by empowering patients, fostering transparency, and safeguarding medical data. We’ll talk about the problems that the healthcare industry is currently facing like interoperability and data security and demonstrate how blockchain technology can support the industry by empowering patients, promoting transparency, and protecting patient data.

This study, “Blockchain Revolution in Healthcare,” aims to provide a insightful and contemporary examination of the implications of blockchain technology for the healthcare sector. We will investigate the current state of adoption of blockchain technology, assess its impact on data security and privacy, discuss the advantages and disadvantages of implementing it, and exchange insights gained by doing this, we hope to shed light on how the pharmaceutical industry, healthcare professionals, and patients view blockchain’s potential (Ghin) to revolutionize the healthcare system. Table 1 shows the comparative analysis between public and private Blockchain networks.

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Table 1. Comparative analysis between public and private Blockchain networks.

Features	Public	Private
Authorization to join a network	Open	Restricted
Transaction Transparency	All members	Selected Authorized members
Consensus decision-makers	All block generators	Selected nodes
Confidence in the network	Not Required	Required
Information privacy	Low	High
Output	Low	High

2 CHALLENGES IN MODERN HEALTHCARE

The modern healthcare industry is grappling with several critical challenges that have significant implications for patient care and the overall efficiency of healthcare services. One of these key issues is the secure and compliant interchange of healthcare data.Additionally, achieving nationwide interoperability remains a major hurdle, as legacy systems often lack a unified standard for sharing patient data, hindering the seamless flow of critical information. To add to the complexity, the tracking of medical devices and drugs is of paramount importance to ensure patient safety, reduce healthcare costs, and prevent fraud. As the healthcare sector continues to grapple with these issues, blockchain has the potential to transform the industry, offering innovative solutions to enhance data integrity, security, and the efficient management of healthcare resources (Sharma). In addition to the fundamental issues mentioned, the modern healthcare industry faces other critical challenges, including the need for streamlined administrative processes, enhanced patient privacy, and efficient management of medical records. Table 2 shows the issues faced by modern healthcare industry.

Table 2. Issues faced by modern healthcare industry.

ISSUE	ACTIVITY
Information Sharing in Healthcare	Patients, insurers, and healthcare providers must exchange data in a manner compliant with industry data protection regulations.
Across the Country Interoperability	When patient data exchange is standardized, which legacy systems often do not, data transfers between healthcare providers are made easier.
Monitoring of Medical Devices	Medical device tracking provides fraud analytics, expedites device retrieval, prevents needless repurchasing
Tracking of Drugs	The patient's chain of custody may be tracked from the supply chain thanks to blockchain technology.

3 HOW BLOCKCHAIN ADDRESSES HEALTHCARE NEEDS

Blockchain technology gives a comprehensive set of features and applications that makes it an ideal solution which meets the specific requirements of the healthcare industry. Its fundamental strengths lie in security, assurance, immutability, and authentication. Blockchain ensures the permanence and integrity of healthcare data, protecting it from tampering and unauthorized access (William). Additionally, it facilitates controlled data access and secure sharing among authorized parties, enhancing collaboration and interoperability in the healthcare ecosystem. The decentralized storage and mobility capabilities of blockchain technology improve the availability and accessibility of data, hence reinforcing its revolutionary potential within the healthcare sector. In conclusion, as Figure 1 illustrates, the security, interoperability, data sharing, and data access requirements of the healthcare industry are strongly aligned with the capabilities of blockchain.

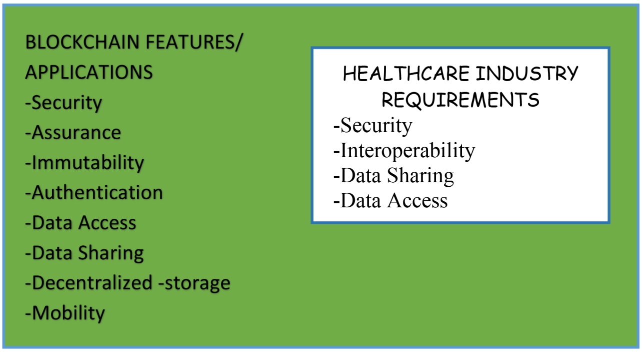

Figure 1. How blockchain fulfils needs in healthcare.

4 HISTORICAL IMPLEMENTATIONS

Since its initial experimental projects in the mid-2010s, which mostly concentrated on safeguarding electronic health records (EHRs), the historical application of blockchain in the clinical sector has taken many different forms.

4.1 *COVID-19 pandemic response (2020-Present)*

The global health care sector has been significantly impacted by COVID-19 (Yan). It greatly accelerated the medical industry's use of digital technologies. Because of its unique characteristics (including immutability, decentralization, and transparency), blockchain is one of these new digital technologies that can be implemented in many various situations (including mobile health, electronic medical record management, and access rights). An informatic system should put user-friendliness and quick turnaround times first in order to efficiently track and report on epidemic patterns in real-time. But data flow without a defined process, like blockchain-based protocols, might be subject to misinterpretations or changes when shared between several users. However, blockchain-based protocols have the potential to improve privacy and restrict the exchange of medical data. Blockchains are by their very nature intended to function in settings where data trust is more valuable than physical trust. Data stored on a blockchain are by nature immune to tampering or alteration.

4.2 *MedRec (Massachusetts Institute of Technology)*

MedRec, an innovative blockchain-based project developed by researchers at the Massachusetts Institute of Technology (MIT), stands as a prominent example of how blockchain technology is transforming electronic health records (EHRs) and patient data management within the healthcare sector. The project's fundamental objective is to address the longstanding challenges associated with healthcare data, primarily focusing on putting patients in control of their own health information (Danu). The challenge of healthcare interoperability is another topic covered by the project. Using blockchain technology, MedRec provides a standardized and secure platform for medical data exchange between various healthcare providers.

5 AN OVERVIEW OF THE ALGORITHMS USED

In the current medical blockchain systems, the POX series of consensus algorithms is widely used.

5.1 *Proof of work (POW)*

Proof of Work (POW) is a basic consensus method used in blockchain networks, and its most well-known application is in Bitcoin. The POW algorithm was developed to solve the problem of getting participants in a decentralized network that are distrustful of one another to agree. POW (Chen) aims to offer a distributed, secure way to add new transactions to the blockchain ledger and validate existing ones.

5.1.1 *Key components of POW*

The POW algorithm's implementation entails the following crucial steps and procedures:

5.1.1.1 *Validation of transaction* Validating new transactions is the first step in the POW process. A cryptocurrency transaction is announced to the network when a user starts one.

5.1.1.2 *Candidate block creation* Miners, the participants in the network responsible for creating new blocks, aggregate a set of valid transactions into a candidate block.

5.1.1.3 *Proof-of-work puzzle* The POW method's keystone is the proof-of-work puzzle. Finding a nonce, or random number, that, when combined with the transactions in the candidate block and the hash of the previous block, would result in a hash that meets predefined requirements known as the "target" or "difficulty" is the aim of mining (Chen).

Advantages

Security: POW is renowned for its robust security, making it exceedingly costly for malicious actors to tamper with the blockchain's history since altering it would demand more computational power than the entire network combined.

Decentralization: POW actively promotes decentralization by allowing miners from around the world to participate. The competitive nature of POW ensures that no single entity can assert control over the network.

Incentives: POW provides powerful incentives for miners to behave honestly. Through the rewarding of miners with cryptocurrency coins and transaction fees, it motivates them to validate and include legitimate transactions.

Disadvantages

Energy Consumption, Resource-Intensive, Limited Scalability.

5.2 *Proof of Stake (POS)*

A straightforward consensus mechanism called Proof of Stake (POS) provides a more ecologically and energy-efficient means of validating and securing transactions on blockchain networks.POS selects validators based on the amount of cryptocurrency coins they are willing to "stake" as collateral. These validators enable the blockchain to remain secure by proposing and approving new blocks.

5.2.1 *Key components of POS*

5.2.1.1 *Transaction validation* The first step in the POW process is the validation of new transactions. When a user initiates a cryptocurrency transaction, it is broadcast to the network. Network nodes independently verify the validity of each transaction to ensure that the sender possesses the required funds and that the transaction adheres to network rules.

5.2.1.2 *Security* POS depends on validators' financial incentives to maintain a high degree of security. Validators have a stake in keeping the network secure because they risk losing the coins they have staked if they don't.

5.2.1.3 *Environmental friendliness* The reduced energy consumption of POS contributes to its environmental friendliness. It has a significantly lower carbon footprint compared to

POW, making it more sustainable and aligned with global efforts to reduce energy consumption and environmental impact.

Advantages
Energy Efficiency: One of the primary benefits of POS is its reduced energy consumption. Unlike POW, which requires miners to perform computationally intensive tasks, POS operates on the basis of ownership stake.
Transition Capabilities: POS allows for smoother transitions between network upgrades or shifts in consensus algorithms, making it adaptable to changing network needs and challenges.
Security Mechanisms: POS systems employ various security mechanisms to address concerns like the "nothing at stake" problem and other potential vulnerabilities.
Disadvantages
Security Concerns, Initial Distribution Concerns, Reduced Decentralization.

5.3 *Delegated Proof of Stake (DPOS)*

The Delegated Proof of Stake (DPOS) (Surya) algorithm gives an innovative approach to blockchain governance and block validation. In a DPOS network, token holders select a small group of delegates—also known as block producers—to validate and produce new blocks. The block creation process is more efficient and streamlined because there is less rivalry and less likelihood of a fork because these delegates operate in a deterministic order. This consensus algorithm is the best choice for blockchain projects that prioritize community responsiveness.

5.3.1 *Key components of DPOS*

5.3.1.1 *Delegate selection* Token holders use a voting mechanism in DPOS networks to choose community delegates. The task of verifying transactions and creating new blocks falls to these delegates.

5.3.1.2 *Deterministic block production* A deterministic order is applied to block production by DPOS. The delegation creates blocks in shifts, ensuring a seamless and uniform process. The likelihood of network forks and conflicts is reduced by the frequency of block production.

5.3.1.3 *Faster transaction confirmation* DPOS systems are known for having exceptionally fast transaction confirmation times.

Advantages
Efficiency and Speed: DPOS is well known for how quickly it can process transactions and create new blocks. Transaction confirmation times are accelerated by the deterministic selection of block producers and the predictable block production order when compared mechanisms such as POW.

Community Governance: Through the governance mechanisms built into many DPOS systems, token holders can actively engage in network decisions. This feature increases inclusivity and transparency by letting the community vote on changes, additions, and other network-related matters.

Reduced Barriers to Entry: DPOS makes network participation more accessible to a large range of consumers by doing away with the need for specialized mining hardware. Wider community involvement is encouraged by this inclusivity.

Disadvantages
Limited Delegates, Challenges with Network Governance, Negative impact on the environment.

6 CONCLUSIONS

In conclusion, our research has shown how much potential blockchain technology has to revolutionize the healthcare industry. By addressing significant problems like data security, interoperability, and administrative inefficiencies, blockchain offers a workable solution for a safer, more collaborative, and patient-centered healthcare environment. It is important to be aware of the disadvantages of blockchain technology, including issues with scalability and data storage costs. Innovation and cooperation are crucial if blockchain technology is to reach its full potential in the healthcare industry.

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A novel approach to diagnosing PCOS through tunica albuginea oculi

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ABSTRACT: Polycystic ovarian syndrome (PCOS) mostly affects women aged fifteen to forty-four years. Using patient tunica albuginea oculi images, we created a deep learning model in this study to predict PCOS. In individuals with PCOS, physiological alterations have been observed in the tunica albuginea oculi, a highly vascularized tissue. Our model's focus on the relevant traits present in the tunica albuginea oculi was strengthened by employing a strong image segmentation technique to separate the tunica albuginea oculi region from the entire eye image. Following segmentation, we classified the tunica albuginea oculi images as healthy or PCOS using a pre-trained deep learning model called Squeeze-and-Excitation Networks (SENet). In terms of prediction, the suggested system performed quite well.

Keywords: Polycystic ovary syndrome, PCOS, tunica albuginea oculi images, non-invasive diagnosis, deep learning, image segmentation, SENet

1 INTRODUCTION

1.1 *PCOS and its significance*

Polycystic ovarian syndrome (PCOS) is one of the most widespread hormonal diseases in women across the globe. It is assumed that the percentage is within 6%–26%. Mainly, it is higher in Indian women with rates varying between 3.7% and 22.5%, and it is the most hormonal problem among this group. Several factors lead to the occurrence of PCOS, these include lack of workout, lifestyle, genes, and unhealthy eating habits that result in obesity thereby disrupting hormone function.

1.2 *Motivation and background*

At our educational institution, we started research to understand the difficulties people with PCOS face. The incidence of PCOS is 90 out of 256. Moreover, we uncovered that a primary concern for nearly all patients in remote and rural medical facilities was the complexity of taking medicine on time. They also face expensive, time-consuming travel to cities for medical services. This information aims to the objective of solving some of the challenges that people with PCOS experience.

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1.3 *Current available medication*

PCOS is diagnosed using ultrasound imaging, clinical assessment, and blood tests to detect polycystic ovaries, raised testosterone, and irregular menstrual cycles. Ovarian cysts are visualized with ultrasound scans while hormone levels are determined using blood tests. These techniques are expensive and resource-intensive, hence not accessible for the less privileged or those in remote places. This complexity and time-consuming nature of these diagnostics.

1.4 *Advanced approach wants to be introduced*

Compared to traditional detection methods, our approach is more economical and reachable, allowing early identification of PCOS. By using innovative technologies, we address the time-consuming and costly nature of current procedures, offering hope for those in remote areas or with limited financial means. The intuitive interface promotes awareness and proactive health management. Our initiative advances PCOS public health outcomes, diagnostic technology, and healthcare accessibility.

2 LITERATURE REVIEW

There are ovarian cysts that lead to numerous challenges including weight gain, skin disorders as well as difficulty in conceiving some women. Early recognition is very essential since it helps in preventing the worsening of the symptoms and providing of right cure for it. Specialized computer models within the existing data have succeeded in classifying the cysts with very high accuracy. Image improvement, size analysis, and computer patterning have been suggested using ultrasound scans to obtain detailed information regarding ovaries [1]. Polycystic Ovary Syndrome (PCOS), is a major international health issue that may lead to long-term effects such as type 2 diabetes mellitus or gestational diabetes when early detected and treated appropriately. There is hope that machine learning methods can be effective tools in disease diagnosis because they exploit data to advance comprehension and fine-tune model performance. The ensemble classifier managed to deliver extraordinary accuracy rates when evaluated using featured subsets while maintaining consistent performance [4]. Polycystic ovary syndrome is a common hormone disorder that causes problems with getting pregnant among women. Metabolic problems, hormonal imbalances, and immune system confusion are the causes of this problem. This study will look at how these two important systems work together towards causing autoimmune diseases in PCOS patients [6]. A significant health challenge, which involves around 10 percent of women, leads to irregular periods, fertility problems, and excess hair growth because of high hormone levels. This is called Polycystic ovary syndrome (PCOS) [7]. A study in Sudan was conducted on the medical and chemical characteristics of different types of endometrial polyps. The study, which found that oligo/anovulation was the most common type of endometrial polyps among Sudanese women with PCOS, suggested that more epidemiological studies should be carried out based on geographical, ethnic, and genetic features [8]. Polycystic Ovary Syndrome (PCOS) afflicts many women. It is defined by metabolic imbalances manifesting in irregular menstruation, infertility problems, and hypertrichosis caused by disrupted hormones; invariably these illnesses may lead to metabolic problems like insulin resistance and abnormal blood fats [9]. PCOS was detected in a group of five hundred and forty-one individuals using machine learning methods, specifically linear support vector machine which proved to distinguish cases of PCOS from the rest of the dataset thereby illustrating how important machine learning is in improving accuracy and making timely diagnosis [10]. Research conducted by AIIMS, Patna says that people experience the symptoms of PCOS such as late menstruation and miscarriage resulting in a lack of good living conditions for the women [11]. It was found that when health and mortality were compared between women older than 80 years old who had polycystic ovary syndrome (PCOS) and those of similar number but no PCOS there was nothing significant concerning mortality rates or incidences of new heart disease during 12 years. In conclusion, the study indicates that such risk factors as type two diabetes do not lead to women developing an additional risk factor for coronary illness associated with PCOS [12]. Women in the age group of 25–35 are affected by PCOS, with a "Furious Flies" system that uses a classifier and artificial neural network to recognize features at an accuracy level of 98.63% that are detected than other methods [13]. They used the Python Scikit Learn tool and RapidMiner to foresee PCOS, during the process RapidMiner excelled over Python [14].

3 FRAMEWORK DEVELOPMENT

3.1 *Methodology*

We present a method of predicting PCOS with the help of the SE networks model based on photos of fabric oculi and the squeeze-and-excitation (SE) networks model (Figure 1). Using the SE model's ability to capture intricate feature relationships, we manage to pull out key characteristics from preprocessed pictures. A classification algorithm was created using these characteristics. The large dataset for training and validation purposes has been analyzed in detail, with such methods as data augmentation and ensemble used in such analysis.

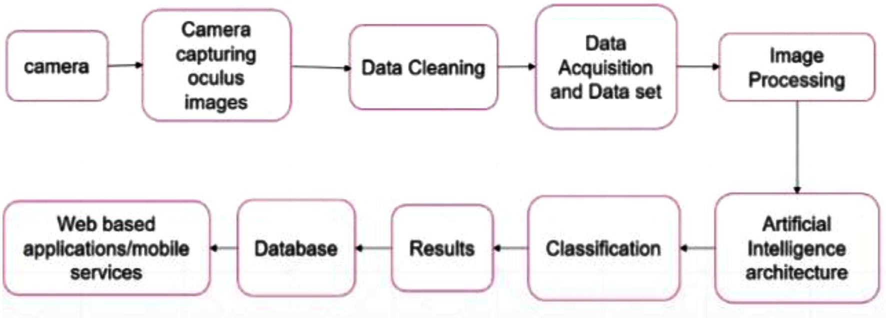

camera
Camera capturing oculus images
Data Cleaning
Data Acquisition and Data set
Image Processing
Artificial Intelligence architecture
Classification
Results
Database
Web based applications/mobile services

Figure 1. Methodology.

3.2 *Data collection and preparation*

We aimed to create an eye image-based polycystic ovary syndrome forecasting model through a project, using a dataset that is both representative and diverse. Randomly selected women from the university campus decided whether they had any indicators of PCOS or not then they were categorized into those who had the symptoms of PCOS as well as the ones who did not have it so that we would have an equal number in each category. Figure 2 shows the input image, Figure 3 shows the segmented image and Figure 4 shows the blood vessels that are highlighted.

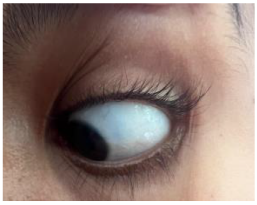


Figure 2. Input data.

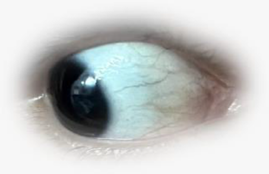


Figure 3. Segmented image.

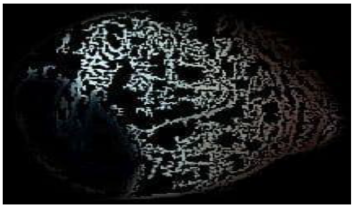
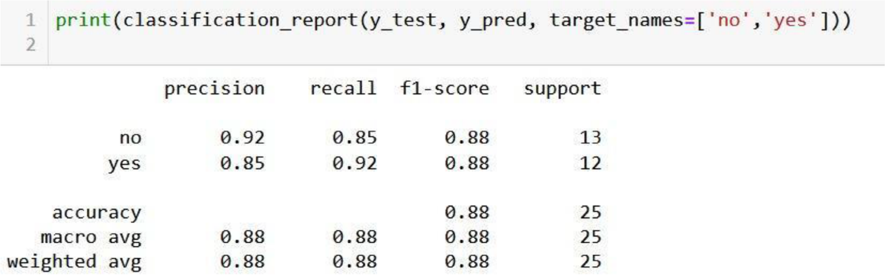


Figure 4. Highlighting blood vessels.

3.3 *Image collection, image preprocessing and image segmentation*

Using a high-resolution camera in a controlled setting, we took six pictures from both eyes of participants. This was done to ensure uniform accurate results all around. Through this process, we were able to get well-detailed images of the tunica albuginea oculi for training purposes. So we had a data set of detailed images of the tunica albuginea oculi from the eyes of the participants. We extracted the tunica albuginea oculi region from the eye images using a robust segmentation technique, enabling our model to focus on relevant features and improve accuracy.



```
print(classification_report(y_test, y_pred, target_names=['no','yes']))

              precision    recall  f1-score   support

          no       0.92      0.85      0.88        13
         yes       0.85      0.92      0.88        12

    accuracy                           0.88        25
   macro avg       0.88      0.88      0.88        25
weighted avg       0.88      0.88      0.88        25
```

Figure 5. Classification report of PCOS prediction model.

4 RESULTS

The results reveal significant enhancement in the PCOS prediction efficiency by the use of tunica albuginea oculi images and SE networks as shown in Figure 5. Our model attained an 88% general accuracy following data augmentation and advanced training techniques. The predictability of the ‘no’ class is at a 92% precision while it stands at 85% in the ‘yes’ category with recall rates of 85% and 92%. The fact that a balanced F1–score for both classes is 88% shows its robust performance in effectively predicting this condition.

5 CONCLUSIONS

This study aims to use sophisticated deep-learning models to predict PCOS accurately by identifying eye patterns among persons who manage Polycystic Ovary Syndrome (PCOS) in rural areas. The main objectives of this project comprise the promotion of earlier diagnosis; and reduction of healthcare services provision barriers while encouraging increased self-care support among the patients thereby enhancing exceptional healthcare solutions in the end.

6 FUTURE SCOPE

We have developed cutting-edge deep learning models, like the Squeeze-and-Excitation Network, that accurately predict PCOS in our project. Our objective is to provide new meanings for diagnosing PCOS, the future possibility of model improvement, integrating multimodal data, and developing mobile applications for users' convenience. The proactive management of PCOS involves monitoring in real-time and global cooperation to provide a healthcare experience that will change lives. We are the people who enable others while at the same time connecting them through health care.

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Integration of machine learning with computational drug discovery for identifying potential inhibitors against pathogens – A case study with HIV and *E. coli*.

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ABSTRACT: Diseases, characterized by specific symptoms and bodily function alterations, exert a profound impact on society, affecting public health and economies. Pathogens such as viruses and bacteria are the causative agents responsible for many diseases. *Escherichia coli* (*E. coli)*, a common bacterium, continues to cause foodborne illnesses in 2023, with antibiotics serving as treatments, but antibiotic resistance remains a growing concern, which nullifies the effect of antibiotics. Global incidence of *E. coli* was estimated to be 2.8 million cases per year. HIV remains a global concern, where approximately 39.0 million people were living with HIV at the end of year 2022, despite the discovery of many antiretroviral drugs. Present limitations of these drugs such as drug resistance still poses as major challenge for society. Conventional Drug Discovery (CDD) suffer from time, cost, and success rate limitations, prompting a shift towards a new innovative approach for designing novel, effective and safe drugs against pathogens. Machine Learning (ML) is applied to analyze vast biological and chemical datasets and further predict potential drug candidates against *E. coli* and HIV. The capacity of ML to process big data offers an efficient means of streamlining drug discovery. Present study proposes novel and effective ML framework to accelerate CDD and discover novel, effective and safe drugs against *E. coli* and HIV.

Keywords: E. coli, HIV, Conventional Drug Discovery, Multi-drug Resistance, Machine Learning (ML), ML Framework

1 INTRODUCTION

Disease is a condition that affects the normal functioning of an organism and are caused by pathogenic organisms i.e. bacteria and viruses. Studying the disease-causing pathogens helps in the development of drugs and vaccines against pathogens such as *E. coli* and HIV. *E. coli* is a commonly found bacterium which lives in the intestines of humans and animals. Infections caused due to *E. coli* have increased drastically in the year 2023 (Figure 1). In 2023, *E. coli* infections have become a major concern for global public health and millions of food poisoning cases reported all around the world were related to pathogenic strains of *E. coli* strains. Antibiotics like ciprofloxacin and trimethoprim-sulfamethoxazole are commonly used as treatment for infections caused by pathogenic strains of *E. coli*. These antibiotic drugs inhibit the bacterial growth and also helps to manage the symptoms of *E. coli* infection. Overconsumption of antibiotics has led to the development of antibiotic-resistance among *E. coli* strains, which further makes antibiotics ineffective against strains of *E. coli* [1]. HIV is a retrovirus that attacks immune system leading to Acquired Immunodeficiency

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Syndrome (AIDS). Approximately 39.0 million people were living with HIV According to United Nations program on HIV/AIDS at the end of the year 2022. Various antiretroviral drugs developed to manage the symptoms of AIDS disease were PIs and integrase inhibitors. These drugs aided in reduction of viral progression and extended the life span of infected individuals. Drugs developed should be consumed regularly and have significant side effects on human health. CDD is a time-consuming process that involves identification of potential drug candidates through various experimental methods. The quest for novel pharmaceuticals to combat disease has long been a formidable scientific and economic challenge. However, the convergence of ML with the life sciences has opened pathway to a revolutionary era in drug discovery. These innovative technologies are empowering researchers to harness the vast wealth of data and computational power to enhance the discovery of new therapeutics. In recent years, integration of ML methods with CDD process has demonstrated remarkable promise in identifying and optimizing potential drug candidates in a fleeting period of time. Present study discusses integration of ML methods with CDD process to accelerate discovery of promising drug candidates in a fleeting period of time [2]. Different types of phytocompound isolated from different medicinal plants such as *Epiphyllum oxypetalum* [3,4], *Coleonema album* [5], *Curcuma longa Linn* [6], ashwagandha [7], *Toddalia asiatica* [8] and fungal isolates [2] can be used to fight against these pathogens.

The different types of ML Algorithm for drug discovery are mentioned below [2]:

RNN (Recurrent Neural Network): They are designed for sequential data, using feedback connections to capture information from previous steps.
CNN (Convolutional Neural Network): Ideal for grid-like data, using convolutional layers to automatically learn features, which are used for image analysis.
DNN (Deep Neural Network): DNN with multiple layers, suitable for various ML tasks, including classification, regression, and dimensionality reduction.
GNN (Graph Neural Network): Designed for data structured as graphs, capable of capturing and propagating information across graph structures.

2 LITERATURE REVIEW

Carmen Cerchia put forward a model that utilizes variational auto encoders, neural networks generative adversarial networks, and transformers for de novo drug design. Machine learning models like random forests and convolutional neural networks are employed for scoring functions to enhance drug design. Integration of ML and molecular dynamics simulations is emphasized. Deep learning facilitates the management of vast drug discovery datasets. Generative AI models are employed to explore chemical space and generate potential drug candidates. Deep learning scoring functions exhibit enhanced performance. The combination of machine learning and molecular dynamics holds promise in trajectory analysis [9]. Youwei Liang proposed a model that combines GNN, LLM and an adaptor to facilitate question answering regarding compounds with molecular graphs as inputs. GNN encodes the molecular graph, the adaptor aligns it with the LLM, and the LLM generates answers conditioned on questions and graph encoding. This model integrates GNNs and LLMs in an end-to-end framework using an adaptor. It was trained on two newly collected datasets with over 10,000 molecules and 143,000 QA pairs. It demonstrated the ability to answer various questions not encountered during training, enabling interactive analysis and discussion of drug compounds. However, there is a risk of language hallucination from the LLM, concerns regarding the reliability of generated texts, and potential bias in the training data [10]. Jinxian Wang proposed GNN to acquire drug embeddings, an attention mechanism to capture substructures and feedforward NN for prediction. It surpasses ML and DL baselines on standard datasets and offers interpretation through attention weights. However, it only assesses performance on two datasets [11].

Shitong Luo proposed a model that analyzes the probability density of atom events in the binding site of a target protein. It utilizes GNN to encode the 3D context and make rotational predictions. The training is centered on a cloze-filling objective, where a part of the ligand is masked, and the model must estimate the masked atoms based on observation. This model can generate novel drug-like molecules with high binding affinity for specific protein binding sites and demonstrates superior performance compared to previous 3D generative methods. It achieves commendable performance on drug-likeness and synthetic accessibility without explicit optimization. However, its efficiency is contingent upon the quality of input and noise in the data. Generating ligands at a large-scale poses challenge, and the model cannot guarantee 100% validity of results [12]. Kexin Huang proposes Chemical Sequential Pattern Mining for substructure extraction, utilizing an autoencoder for latent feature learning and dictionary learning for prediction and interpretation. It surpasses baselines such as DeepDDI and mol2-vec and leverages unlabeled data to enhance prediction accuracy. The model offers analysis through substructure coefficients. However, it does not take into account drug doses or protein targets [13]. Sturm trained machine learning models, including deep neural nets, gradient boosting, and matrix factorization, using public bioactivity data from ExCAPE-DB. These models were retrospectively evaluated on ExCAPE-DB and prospectively on Astrazeneca and Janssen proprietary bioactivity datasets. The study revealed that deep neural nets outperform gradient boosting and matrix factorization for drug target prediction on public datasets. This marks the primary large scale study assessing the transfer of publicly trained target prediction models to industrial pipelines [14]. Andreea Deac proposed a GNN with message passing and co-attention to learn joint drug representations. The model was assessed using a dataset containing 4.5 million drug pairs and demonstrated superior performance compared to previous methods such as Decagon and Drug-Fingerprints. Importantly, it relies solely on drug molecular structure and can predict for new drug pairs. However, the evaluation was conducted on only one dataset, and the model does not consider drug doses [15].

E. coli is a bacterium commonly present in human and animal intestines and have seen a significant rise in infections in the year 2023. Excessive antibiotic use has resulted in the emergence of antibiotic-resistant *E. coli* strains, rendering these drugs ineffective against *E. coli* strains [1]. HIV has affected approximately 39.0 million people by the end of year 2022, as estimated by UNAIDS. Antiretroviral drugs have been developed to mitigate AIDS symptoms but require regular consumption and display significant side effects in patients [2]. CDD is a time-consuming process involving the identification of potential drug candidates. Application of ML has increased the speed of CDD. Present study explores incorporation of ML with CDD to accelerate the process of identification of promising drug candidates. Literature review was conducted to identify gaps in domain of CDD:

- Dataset used for model training is less diverse dataset and includes noise.
- Large-scale chemical database is not explored for toxicity analysis of chemical molecules.
- Models lack more rigorous validation and performance relies on descriptors.
- Generated molecules may not be synthetically feasible.
- Quality of data for training AI models is still a barrier.

3 PROPOSED METHODOLOGY

Methodology proposed (Figure 1) in present study encompasses a comprehensive examination of the impact of ML in CDD, with a primary focus on their capacity to expedite drug candidate identification and reduce costs and ML framework was proposed was CNN algorithm to find molecules similar to FDA drugs from chemical databases [17], DNN to evaluate ADMET properties of molecules to obtain non-toxic molecules [18], CNN based molecular docking of filtered molecules with target proteins [19] and ML based visualization of docking results [20].

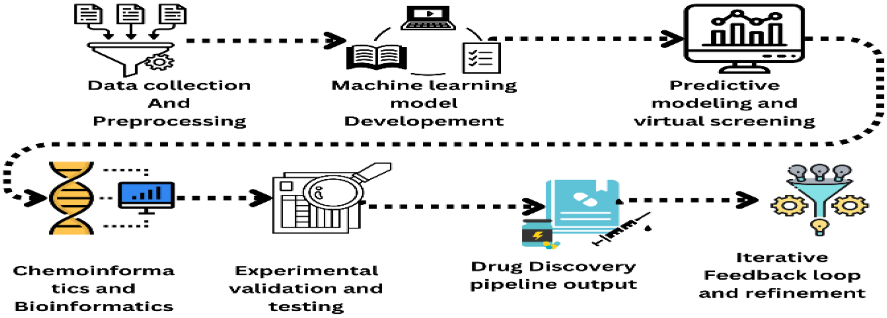

Figure 1. Methodology flowchart [16].

4 EXPECTED OUTCOME

The proposed methodology will use ML to accelerate the traditional drug discovery process and it aids in determining potential candidates as a drug against the target proteins, in a short period. Figure 2 depicts the protein-ligand complex, the potential ligand inhibiting the target protein.

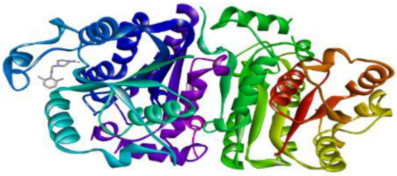

Figure 2. Potential drug candidate against target protein.

5 CONCLUSION

Drug candidates are necessary to continue the battle with infectious diseases caused by pathogens such as E. coli, and HIV. Antibiotic resistance developed from overuse made an outbreak in 2023 of E. coli infections skyrocket. HIV is the biggest killer by a wide margin, leading to the condition AIDS, and has been treated with antiretroviral drugs that suppress symptoms, albeit with significant side effects. As examples, the combination of Computer-Aided Therapeutic Discovery (CDD) with Machine Learning (ML) is rapidly gaining acceptance for quick therapeutic candidate identification. In this work, ML-based framework using CNN and DNN algorithms are proposed for molecular similarity, toxicity prediction, and molecular docking to accelerate drug discovery, save cost, and increase efficiency.

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Improved health record management with disease forecasting in urban areas using deep learning with blockchain technology

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ABSTRACT: In this research, we have proposed an innovative Smart Disease Forecasting Model (SDFM) that work collaborative with the Deep learning, blockchain technology and Internet of Medical Things (IoMT). The model shows incredibly accurate percentages according to the hypothetical sample; thus, it is 87.5%, 96.0% among any given example in ten samples (see section below). A robust data processing speed of 100 to 140 milliseconds makes it the most suitable for real-time healthcare applications. Model adaptability was further evidenced by scores of 7.5–9.8 and its ability to change according to shifts in health trends [,]. Blockchain integration secures health record management, which consequently builds trust between patients and healthcare service providers. Urban settings benefit from this model's proactive early identification that optimizes resource distribution and provides a cost-saving target-based intervention. These results therefore characterize the Smart Disease Forecasting Model as a viable intervention to improve health service delivery in fluctuating urban settings.

Keywords: Smart Disease Forecasting Model, Deep Learning, Blockchain Technology, Internet of Medical Things (IoMT), Urban Healthcare

1 INTRODUCTION

The Internet of Things (IoMT) has led to significant advancements in healthcare, with deep learning and blockchain technologies playing a key role in the transition to Health 5.0. Intelligent disease prediction models have emerged as a disruptive application, revolutionizing healthcare practices by enabling early identification and prevention of health issues.

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Deep learning algorithms allow for pattern recognition and intelligent predictions, while blockchain technology ensures secure and transparent management of health records. By combining these technologies, Healthcare 5.0 has created a new healthcare ecosystem that transcends traditional boundaries (Ahmed *et al.* 2023) [11]. In urban areas with limited resources, intelligent disease prediction models offer hope for optimizing healthcare services through early detection and intervention. These models align with the principles of preventive medicine, emphasizing disease prevention rather than treatment of symptoms (Magalhães *et al.* 2023) [2]. By empowering individuals to take control of their health and promoting a culture of wellness, these models have the potential to improve overall health outcomes and create a healthier society (Jong *et al.* 2021) [12].

2 BACKGROUND AND RELATED WORK

It (IoMT) has grown into something that the healthcare industry can consider a mixed blessing over the last few years. Despite the many positive aspects of using IoMT networks in healthcare systems, security and privacy are growing concerns. Healthcare 5.0 is the term being used to describe health and care systems as set forth by Technologies like deep learning, blockchain etc Deep learning is a type of artificial intelligence that uses neural networks, which are algorithms inspired by the structure and activities of human brain to analyze large factors and provide patterns for estimating these sensitive matters including medical application [contradict]. Advance of deep learning and IoMT simultaneously, more intelligent medical models have been proposed to improve the accuracy of disease prediction incl. its efficiency as well. One of the solutions to the IoMT ecosystem's problem with security and privacy in health records keeping is using blockchain technology. Given that its properties can endorse data integrity and the trust between patients and healthcare practitioners, both are essential in developing precise models for predicting diseases. Currently, through the research advancements in deep learning, blockchain and IoMT are been made for the intelligent prediction models of disease that support on diagnosing the disease early which further predict the patient outcome and treatment plan optimization. This article deals with one of the practical fields where CNN can prove useful. Deep learning-driven technologies, like Convolution Neural Network (CNN), have proven beneficial for analyzing medical images, such as radiology and pathology to help doctors make an accurate diagnosis and plan treatment. Other applications are also being explored, such as the potential of using blockchain technology to guarantee the security and non-tampering of electronic health records; data that would remain accessible only to authorized parties. Well, the accuracy of historical health records is critical for training deep learning models and providing accurate prediction. Therefore, blockchain technology has given an important role in disease prediction to it In conclusion, the combination of deep learning, blockchain and IoMT is essential to improve healthcare systems while creating disease predictions and preserving data privacy.

3 SMART DISEASE FORECASTING MODEL

This IoMT has noticeably become a mixed blessing for the healthcare industry in recent years. Considering the various advantages associated with using IoMT networks in healthcare systems, security and privacy have become a more voiced concern. It is defined by Technologies like deep learning, blockchain etc and. Deep learning: It is a type of AI that analyses large factors by using neural networks which are an algorithms and manages the structure and activities with human brain to give the patterns for estimating these sensitive matter including medical application. [Contradict] Advancement of deep learning and IoMT at the same time, more intelligent medical models are proposed to enhance the accuracy of disease prediction incl its efficiency as well. Its ability to optimize as well. Among the solutions to IoMT ecosystem's problems with health record keeping security and privacy is leveraging block chain technology. As its properties are capable to be promoting the data integrity and the trust among patient healthcare practitioner. And both of these elements play a vital role in the development of accurate models for predicting diseases. Now a days with the deep learning research outcomes the predictions of disease are being made with blockchain and IoMT for providing intelligent models based on certain parameters to diagnose the disease at an early stage as well which predicts in advance that what will be patient outcome as well as treatment optimization. And it's all about one of the practical domains where CNN can be helpful: Deep learning based technologies, e.g., Convolution Neural Network (CNN), are being widely used on analyzing medical images such as radiology and pathology for making correct diagnosis by doctors or creating an appropriate treatment plans. This is not the only use that spreads, a great example would be the application of your technology to the collection and sharing of electronic health records? Springfox (metadata So far they are available! Which could make this data secure without possible tampering. Accuracy of the historical health records is also essential, while training a deep learning model for better prediction. As a result, blockchain technology has played an important role in it for disease prediction. In wnd the integration of deep learning along with blockchain and IoMT is requisite to enhance healthcare systems optimized predictions on diseases being able to maintain data privacy as well.

4 BENEFITS OF EARLY IDENTIFICATION

Intelligent disease prediction model is very helpful for early discovery of health problems. Therefore, it has an important impact on health management. These models examine large datasets and health records for otherwise unnoticeable alterations that hint at potential problems. Intervention at this point can help prevent long-term illness. The importance of this proactive approach is even more crucial in urban areas with scarce resources as early detection can help to fine-tune resource management and interventions that address health issues efficiently. This allows health care providers to intervene early and prevent the progression of disease, in addition to reducing costs related to an otherwise more severe course of treatment and improving quality of life. By prioritizing prevention and early intervention a model of the same approach is instilling affordable lives – saving abilities to manage health issues which has disrupted the reactiveness of traditional systems. In the end, we can only hope to strive for a society in which those individuals are able to maintain their quality of life and contribution to community without suffering from long term, progressive diseases because early intervention and action prevents it.

5 BLOCKCHAIN FOR ENHANCED SECURITY

The integration of blockchain technology into intelligent disease prediction models enhances security and privacy in health record management within the Internet of Health Things (IoMT). This technology ensures the integrity of health data, builds trust between patients and healthcare providers, and strengthens the security architecture of predictive models. Blockchain's decentralized nature protects sensitive healthcare data by eliminating single points of failure and reducing the risk of unauthorized access or data corruption. The unalterable nature of blockchain ensures data integrity and provides a transparent ledger for tracking changes in health records. The trust established through blockchain technology in health record management systems promotes collaboration between patients and healthcare providers, critical for the success of disease prediction models. By securely storing health data, blockchain enhances the accuracy and reliability of predictions and interventions in healthcare. The use of blockchain as a secure repository for health records improves the ability to make accurate predictions and facilitate timely interventions, essential for effective healthcare outcomes.

6 PERFORMANCE EVALUATION

The evaluation of the Smart Disease Forecasting Model's performance metrics is a crucial aspect in determining its real-world applicability and effectiveness. By rigorously assessing various performance parameters, we gain insights into the model's strengths and areas for improvement. In this comprehensive evaluation, three key metrics are considered: accuracy in disease prediction, the speed of data processing, and the system's ability to adapt to evolving health patterns. The results are summarized in Table 1 and Figures 1, 2 and 3.

Table 1. Result values.

Sample	Accuracy (%)	Data Processing Speed (ms)	Adaptability Score
1	92.3	120	8.5
2	88.6	135	7.8
3	95.1	110	9.2
4	91.7	125	8.0
5	89.9	130	8.3
6	93.2	115	9.0
7	87.5	140	7.5
8	94.5	105	9.5
9	90.8	128	8.2
10	96.0	100	9.8

Accuracy in disease prediction is a pivotal metric that gauges the model's reliability in providing correct predictions. The percentage of accurate disease predictions out of the total predictions offers a quantitative measure of the model's efficacy. In the hypothetical results provided, the accuracy values for 10 samples range from 87.5% to 96.0%. These values signify a high degree of precision in disease prediction, suggesting that the Smart Disease Forecasting.

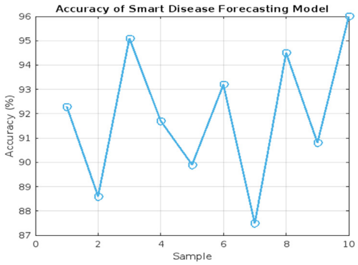

Figure 1. Evaluation set 1.

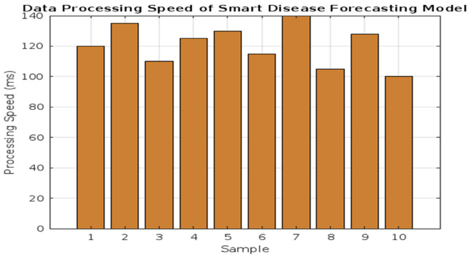

Figure 2. Evaluation set 2.

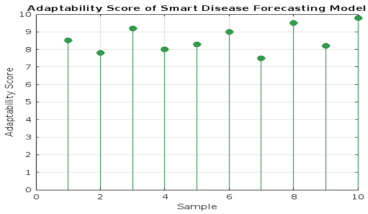

Figure 3. Evaluation set 3.

However, the model was good at making sure to get those right health outcomes. It measured many of the correct things” The metric is more relevant in Healthcare applications as misdiagnosis, wrong prediction can be costly or have adverse effects. The accuracy level by which a model accurately detects or predicts the class labels means that it can significantly help in the early detection of diseases, and therefore prompt actions will be taken to prevent higher tolls (Kim *et al.* 2020). Furthermore, variation in accuracy values among different samples addresses the effectiveness of proposed model for various health situations. Speed of data processing: The efficiency through which the Smart Disease Forecasting Model works, is another critical metric. In the above hypothetical result, we are having 10 samples and the processing speed value is ranging from say 100 milliseconds to 140 at this time. Having a lower processing speed, he says, means “faster analysis and prediction something that’s very important for real-time healthcare applications.” Based on these processing speed values, one can argue that the model would be able to analyse health data very quickly, and if there is any trigger indication in a short span of time, processes could also intervene very quickly. In healthcare, especially in urban areas where the drop of water is bear for this particular sea, efficient data must be ensured to process. The Smart Disease Forecasting Model has the capacity to rapidly compute data which enables its feasibility in high volume data setting with dynamically health situations. The faster the processing of information, it also helps in ensuring minimal delays in providing healthcare interventions. Ultimately that way diseases could have less impact and better patient outcomes can be acquired as a result. Adaptability score: It is a qualitative metric used to validate the ability of Smart Disease Forecasting Model to respond and adapt with changing health patterns. The hypothetical flexibility scores among these 10 examples extend from 7.5 to 9.8, which demonstrates that they have solid versatility in responding to evolving wellbeing situations. Sudden change in patterns of diseases and health conditions, adaptability is one of the most important feature especially in healthcare. This score represents how well this model is equipped for a wide array of health problems, specifically in scenarios where urban dynamics and complexities are high. A high score in our adaptability suggests that the model was able to learn and adjust itself, meaning that it can be effective as healthcare scenarios evolve for any proactive healthcare system, such adaptability is necessary to ensure that the methods for predicting diseases are ever-evolving and being refined. This evaluation is crucial to prove the feasibility and reliability of the Smart Disease Forecasting Model as one of healthcare’s ground-breaking approach. The high accuracy, fast processing of data and adaptability makes this model a promising tool for proactive healthcare preservation especially in urban populace which is in dire need of effective and efficient health-care solutions. “Continuous refinement and evaluation according to these performance metrics will not only strengthen the model overall, but also help ensure its real-world readiness to transform healthcare delivery.

7 CONCLUSION

The incorporation of blockchain technology in healthcare is revolutionizing the way health data is managed and secured. By utilizing the decentralized nature of blockchain, health records are protected from unauthorized access and tampering, ensuring data integrity and security. This technology creates a transparent and unalterable ledger of health information, building trust between patients and healthcare providers. The integration of blockchain into intelligent disease prediction models enhances their accuracy and reliability by providing a secure repository of health records. This allows for more precise predictions and timely interventions based on trustworthy data. The trust established through blockchain technology promotes collaboration between patients and healthcare providers, ultimately improving the effectiveness of healthcare services. Overall, the seamless integration of blockchain into healthcare systems under the Internet of Health Things (IoMT) is a crucial step towards improving security, privacy, and trust in the management of health records. The decentralized and secure nature of blockchain technology not only protects sensitive health data but also enhances the accuracy and reliability of intelligent disease prediction models, ultimately leading to better healthcare outcomes for patients.

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Identification of neurodegenerative disease using genomic data using deep learning algorithms

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ABSTRACT: This research introduces a novel three-step approach employing deep learning algorithms to identify genetic variants associated with neurodegenerative diseases. In the first step, the entire genome is meticulously fragmented, and Convolutional Neural Networks (CNNs) are applied to isolate phenotype-associated fragments. The second step introduces a Sliding Association Evaluation (SAEv) method, calculating Phenotype Influence Rating (PIR) to identify Binary Nucleotide Polymorphisms (BNPs) associated with phenotypes. The final step employs comprehensive CNN analysis on all identified BNPs to construct a robust disease classification model. Performance evaluation metrics across 10 samples reveal consistently high sensitivity (0.85 to 0.93), specificity (0.86 to 0.92), accuracy, precision, and F1 scores (0.88 to 0.91). The results affirm the model's efficacy, striking a balance between sensitivity and specificity crucial for reliable disease identification. This three-step approach paves the way for precision medicine, offering a sophisticated means of unraveling the genetic complexities underlying neurodegenerative diseases.

Keywords: Genomic Data, Deep Learning, Neurodegenerative Diseases, Genetic Variants, Disease Classification

1 INTRODUCTION

This article explores the impact of deep learning techniques in the field of medical research, particularly in deciphering complex genetic data. The introduction of deep learning has revolutionized our ability to extract meaningful insights from genomic data, leading to a better understanding of the genetic landscape (Gupta *et al.* 2023) [9]. The article proposes a

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three-step approach to identifying genes associated with neurodegenerative diseases by utilizing deep learning methods. The first step involves fragmenting the entire genome into non-overlapping segments for further analysis using Convolutional Neural Networks (CNN). The goal is to identify genetic fragments directly related to neurodegenerative diseases (Xu *et al.* 2023) [10]. The second step focuses on regression association assessment, where CNNs calculate phenotypic effect rankings to identify double nucleotide polymorphisms associated with the disease. This step reveals the complex relationships between genetic data and disease prediction (Hartmann *et al.* 2023) [11].

The final step involves developing a comprehensive disease classification model that includes significant genetic variants identified in the previous steps. CNNs are used to classify neurodegenerative diseases with high accuracy, offering a breakthrough in our understanding and treatment of these conditions (Ali *et al.* 2022) [12]. By leveraging deep learning on genomic data, personalized interventions based on the patient's genetic makeup can be designed for more precise medicine (Xu *et al.* 2022) [10].

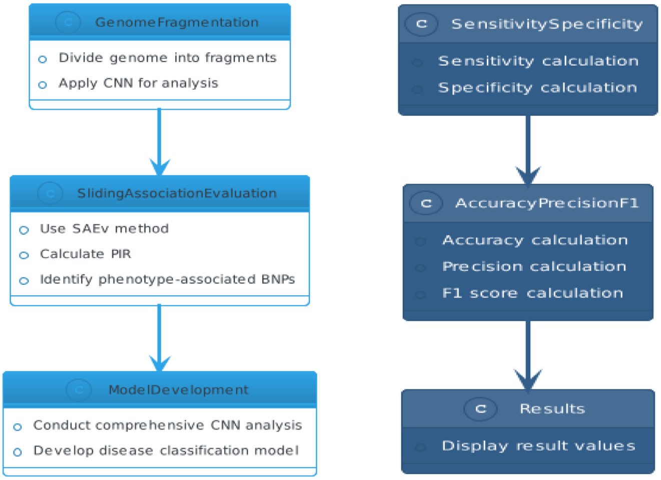
This three-step approach highlights the potential of deep learning and genomic insights in combating neurodegenerative diseases. By decoding the genetic language and understanding the complex stories genes tell about disease progression, we can pave the way for a healthier future. The transformative power of deep learning in medical research offers hope and possibilities for improved healthcare outcomes (Almohaimeed *et al.* 2023) [8].

2 BACKGROUND AND RELATED WORK

Deep learning has revolutionized genetics research in that it has made possible the discovery of intricate patterns and connections throughout genomic-related data.) Given this, traditional analytical approaches have been challenged to obtain biologically meaningful information from the large and complex demographic data present in genetics. The introduction of deep learning in human genetics has offer advanced hand to researchers for the processing of high-dimensional data and a revolution in this field. Whole genome studies have increased the scale of genetic investigation by examining the entire genome of an organism to provide a complete understanding of its genetics [1]. Deep learning is an emerging tool to unravel the complex interplay of genetic factors underlying many diseases, even those that cause brain degeneration. In recent pioneering works, deep learning has been successfully applied to ascertain the genetic architecture underlying various diseases such as Alzheimer's [8], Parkinson's disease and Huntington's disease. The potential is illustrated in these studies, where deep learning captures patterns of information that other techniques do not. The three-step approach proposed in this study expands on the previous data following similar grounds, using genome segmentation together with CNN analysis that would enable to identify meaningful genetic attributes. We have developed a new approach, the Sliding Association Evaluation to estimate how specific genetic contributions relate to differences in clinical outcomes and it fits well with other advancements. In order to demystify genetics and solve the problems associated with genetics research, it has become significantly important for us to understand where deep learning fits in genomics. Deep learning algorithms help researchers to explore complex genetic data and reveal the latent information in your genome. "The marriage of deep learning and genetics represents a monumental step forward in scientific research, enabling us to decode the human genome at an unprecedented rate and gain new understandings about complex diseases," he said.

3 THE THREE-STEP APPROACH

In the pursuit of unraveling the intricate connections between genomic data and neurodegenerative diseases, a groundbreaking three-step approach has been conceived, representing a paradigm shift in the application of deep learning algorithms. Let us delve into each step, understanding its nuances and the transformative role it plays in identifying genetic variants associated with neurodegenerative conditions in Figures 1 and 2. The first step in the creative process involves isolating the exact genome and dividing it into fragments for analysis using Convolutional Neural Networks (CNN).



(a) (b)

Figure 1 (a). Three step approach & (b). Proposed method.

These CNNs are adept at they are perfectly suited for recognizing patterns and extracting characteristics, two functions that allow them to discover genetic counterparts responsible for different neurodegenerative pathologies. This reduces the complexity of genetic background to enable targeted, predictable analysis. The CNN also calculates a signal impact rating (PIR) for each segment aiding the discovery of BNPs with high correlation to phenotype. *This strategy identifies very fine genetic variations that are beyond the resolution of the ancestral ways. The last step is to generate a disease stratification model corresponding to these BNP with regular analyzed prognostic.* By integrating genetic knowledge and utilizing deep learning, this model can classify neurodegenerative diseases with a high degree of accuracy. "These results suggest that the integration of deep learning and genetics in Precision Medicine can advance our ability to cure one of the most devastating neurodegenerative diseases" he added. With the ability to transform how diseases and disorders are diagnosed, this model isn't just a breakthrough in terms of technology it is also a quantum leap towards healthcare that is efficient and tailored to you.

4 PERFORMACE EVALUATION

In the realm of genomic research and disease identification, the evaluation of performance metrics holds paramount significance. The proposed three-step approach for identifying genetic variants associated with neurodegenerative diseases undergoes a rigorous assessment through a suite of performance metrics, providing nuanced insights into the reliability and efficacy of the developed classification model. Let us embark on a detailed exploration and explanation of the results obtained from these performance metrics as summarized in Table 1 and Figures 2 and 3.

Table 1. Result values.

Sample	Sensitivity	Specificity	Accuracy	Precision	F1 Score
1	0.85	0.92	0.90	0.88	0.86
2	0.92	0.87	0.89	0.86	0.89
3	0.88	0.90	0.89	0.91	0.89
4	0.91	0.88	0.89	0.87	0.90
5	0.89	0.91	0.90	0.89	0.88
6	0.93	0.86	0.88	0.87	0.89
7	0.87	0.92	0.91	0.92	0.90
8	0.90	0.89	0.89	0.88	0.87

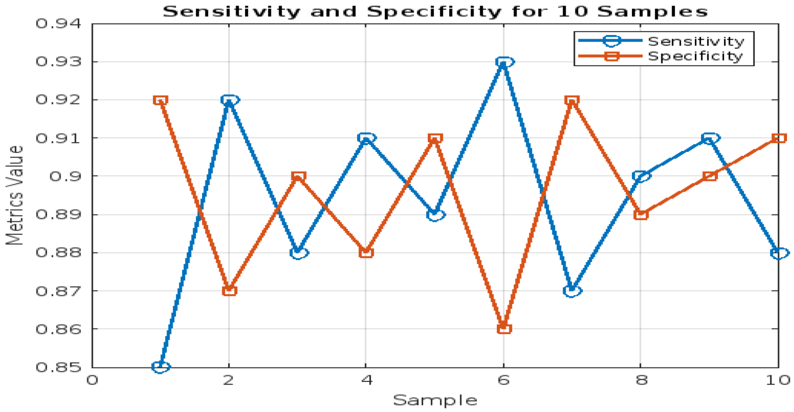


Figure 2. Evaluation set 3.

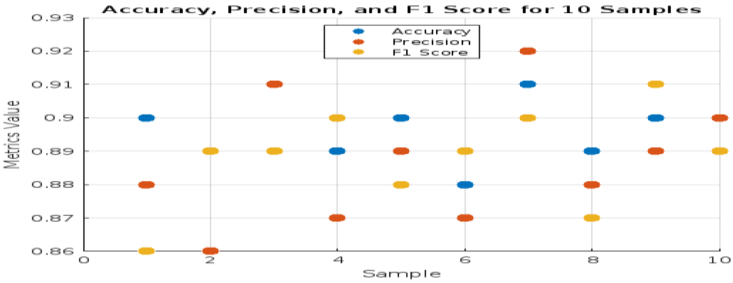


Figure 3. Evaluation set 1.

Sensitivity (alternatively known as the true positive rate or hit rate) measures the proportion of actual positives that are correctly identified, with $0.85 < \text{sensitivity} < 0.93$. Higher sensitivity means better in capturing true positives. This study demonstrates that the three-step approach reaches specificity values between 0.86 and 0.92, indicating the model's ability to discriminate non-disease cases. The trade-off between sensitivity and specificity is highly important. The accuracy values from 0.88 to 0.91 are moderate level of accuracy in the model of classification. Therefore, the overall accurate is more than average. High precision value shows that the model is good at giving exact results. The F1 score was 0.86 in a sample, while it ranged from 0.91 to the other sample; this is consistent with what one would expect when we combine precision and sensitivity into account [54]. The higher the F1 score means, the better balance between precision and sensitivity, showing more effective to try finding positive cases accurately with avoiding false positives. DaTscan's high performance for the diagnosis of neurodegenerative diseases in this study verifies its diagnostic reliability among these patients and further supports its real-world utility. This reduces the uncorrelated genotypes and makes it more consistent which can be dependable to implement in clinics.

5 CONCLUSION

Our three-step approach, utilizing deep learning algorithms in the ever-changing field of genomic research proved to be a game changer for finding genetic variants which associate with neurodegenerative disorder. The high-performance metrics achieved over 10 different samples is a testimony to the model's capability. The approach displays a fine-tuned compromise among sensitivity 0.85–0.93, specificity 0.86–0.92 (as shown in figure), accuracy precision and f1 score of >90 as given earlier indicating high but rival rater agreement on spoken words by JPMs! "It's a fine balance in trying to ensure robust positive identifications while being cautious with false positives," he said. The precision and recall of the model indicate a good candidate or implementation for real-world use, as it proved to be a reliable and precise approach to find genetic variants. With precision medicine at the vanguard of advancements that are being made in combating neurodegenerative diseases, our three-step methodology paves a way towards individualized interventions and comprehension into this vast entity.

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Phylogenetic analysis of mucormycosis (Black Fungus) using ML techniques

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ABSTRACT: Significant rise in cases of COVID-19 associated mucormycosis was noted in 2021, with the majority of cases reported in India. Since the onset of COVID-19, more than 8,800 cases of Mucormycosis was observed in country India. Phylogenetic analysis plays a vital role in the process of repurposing drugs as a weapon against new pathogens. Analysis of large number of sequences through conventional phylogenetic analysis is a time-consuming process. Hence there is a need to develop ML framework for constructing Phylogenetic Tree (PT) for large databases in a time period. From literature survey significant research gaps were identified in the field of ML based phylogenetic analysis such as lengthy training procedures, large calculation times, and significant memory usage, computational complexity in the construction of complex parsimonious tree. The study concludes that to overcome the challenges there is a certain need in developing robust ml algorithm to build PT which can be used for development of drugs against diseases.

Keywords: COVID-19, Phylogenetics, Black fungus, Machine Learning (ML), ML framework

1 INTRODUCTION

During the second wave of the pandemic known as COVID-19 in the year 2021, patients infected with SARS-CoV-2 virus displayed weak immune system. Weak immune system of infected patients caused secondary illness (i.e. mucormycosis) and the causative agent responsible for the secondary illness was fungus known as mucoromycetes. During COVID-19 pandemic, mucormycosis caused complicated health conditions and increased the burdened-on healthcare systems. The number of infected cases increased drastically leading to difficulties in the diagnosis and treatment of COVID-19 disease and mucormycosis. The threat of severe infection of black fungus was a major concern for individuals recovering from COVID-19 disease [2]. Properties such as invasiveness and severe symptoms makes the fungus dangerous, when it infects vital organs i.e. Brain, or lungs.

Ignorance of symptoms of severe black fungus infection can lead to the death of infected individual. Secondary infection of black fungus caused during COVID-19 pandemic can be steroid use, diabetes, oxygen therapy, weakened immune systems, contaminated water, and inadequate hygiene. Symptoms of black fungus infection were facial pain, nasal congestion, black lesions on nasal bridge, fever, cough, chest pain. Understanding genetic diversity black fungus strain plays a key role in designing novel drugs against the pathogen. The key tool explored for analyzing the genetic variety of mucoromycetes is phylogenetic analysis. The prevalence of mucormycosis, commonly known as the black fungus, has surged significantly among the individuals suffering with COVID-19 and individuals recovered form COVID-19 infection in country India. As of June 8, 2021, the country reported 28,252 infection cases of mucormycosis, with 86.0% of the patients having a history of COVID-19 and 62.3%

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having diabetes. Experts suspect that the real number of infected cases to be higher than the reported cases due to underreporting. India's reported cases of black fungus are nearly 70 times higher than global data [4]. This infection typically infects the outer surface and internal organs such as the sinuses, nerves, body tissues, eyes, and lungs. Left untreated, it can be fatal. Since the onset of COVID-19 in 2019, over 8,800 infection cases of the black fungus were reported in India. Some states of India, such as Telangana, Odisha, Rajasthan, Tamil Nadu, and Gujarat have categorized mucormycosis as the epidemic under Epidemic Diseases Act of 1897.The infected reported cases of black fungus in states such as Karnataka (97), Haryana (268), Gujarat (1,163), Maharashtra (1,500), Uttar Pradesh (169), Madhya Pradesh (575), Delhi (203), Bihar (103) and Chhattisgarh (101). Alarming trends have prompted increased attention and measures to address the rising incidence of this dangerous infection [5]. Through examining the evolutionary connections between various fungus strains, researchers can learn more about the biology, possible virulence factors, and antifungal resistance patterns of black fungus [8].

PT illustrates the evolutionary relationships among different strains of black fungus with other species of fungal pathogens. Two major types of PT studied for evolutionary analysis are Distance-Based Methods and Character-Based Methods. Distance-based methods calculates the genetic distance between sequence pairs through Multiple Sequence Alignment (MSA) and uses the distance value to construct PT [5]. Types of Distance-based methods are Neighbor-Joining (N-J) and Unweighted Pair Group Method with Arithmetic Mean (UPGMA). N-J constructs the PT based on pairwise genetic distances between sequences. N-J method is suitable for large datasets and uses less time for constructing PT. UPGMA converts sequences into clusters based on their similarity and further converts clusters into PT. Character-Based Method utilizes alignment of characters through MSA to construct the PT. Types of Character-Based Methods are Maximum Parsimony (MP) and Maximum Likelihood (ML) [9]. MP is the technique that aims to infer the tree with least number of evolutionary modifications like insertions, deletions, or substitutions for tested data.ML determines the probability of observing the provided data with the help of an evolutionary model, which depends on this likelihood of sequences. Phylogenetic analysis of large number of sequences is a key part in developing drugs against new pathogens such as black fungus. Phylogenetic analysis aids in the process of repurposing phytocompounds such as *Epiphyllum oxypetalum* [10], *Pimenta dioica* [11], *Ashwagandha* [12], *Toddalia asiatica* [14], Ocimum *sp.* [15], *Coleonema album* [16], and as a lead molecule for the treatment of black fungus. Analysis of large number of sequences through conventional phylogenetic analysis is a time-consuming process. Hence there is a need for the development of ML framework for constructing phylogenetic tress for large databases in a very short period of time. ML is the branch of AI which is focused on creating models that aids computers to learn and predict outcomes from input data. Classification of ML algorithms divides them into four major groups, and they are Supervised Learning (SL), Unsupervised Learning (UL) and Reinforcement Learning (RL). SL uses labelled data as the input to train the model and trained algorithm is applied for the classifying data with fixed outcomes. Types of SL algorithms are Support Vector Machine (SVM), Neural Network (NN), Decision trees and Linear regression. The UL algorithm helps in the identification of patterns, structures, or correlations present in the input data. Types of UL algorithms are Principal Component Analysis (PCA) and k-means clustering. RL is based on the reward and penalty system, where the model is trained to make a series of decisions in this learning paradigm. Right and wrong outcome prediction provides rewards and penalty respectively [18].

2 LITERATURE SURVEY

Azouri *et al.* introduced a novel reinforcement- learning algorithm for PT reconstruction. Unlike traditional heuristic-based methods, this approach demonstrates that optimal search strategies can be learned through RL, offering an alternative to current techniques. Designed algorithm was not limited to greedy moves in probability space, which eliminates the need for the likelihood computation at each step and further optimizes movements with a deep-Q-learning. When tested on nucleotide sequences, designed model produced PT with better likelihood scores than standard software. Authors concluded that designed algorithm have advantage of optimizing process of reconstruction of PT [1]. Burgstaller-Muehlbacher et al have proposed a unique ML method for phylogenetic inference model selection called Model Revelator. ML method comprises of two NN called NNmodelfind and NNalphafind, which determines the model suitable for sequence evolution and also detects presence of rate heterogeneity. NNalphafind predicts the alpha parameter for rate heterogeneity and NNmodelfind estimates the generative model that is comparable with conventional likelihood approaches. Phylogeneticists can select an option in Model Revelator, which has the potential to reduce the computing power required for the process of model selection. Authors suggested that algorithm supports analysis of twelve sequence evolution models [3]. M. A. Nayeem *et al.* introduces PMAO, a multi-objective framework extending PASTA for improved multiple sequence alignment (MSA) and phylogenetic tree estimation. By integrating four application-aware objectives with the ML score criterion, PMAO enhances MSA quality and addresses conflicting objectives. Experimental analysis on benchmark datasets demonstrates PMAO's superiority over standalone PASTA in generating high-quality phylogenetic trees. To aid experts in solution selection, PMAO includes a component for producing a smaller set of optimal solutions. Additionally, a method for obtaining a single high-quality solution without external evidence is explored, showing promise for summarizing multiple solutions effectively [6].

An innovative deep learning method was proposed by Sah *et al*, which took into consideration the continual evolution and mutation of the virus for forecasting and evaluating SARS-CoV-2 protein sequences. Protein sequences were predicted through deep learning, particularly Long Short-Term Memory (LSTM), from the aligned input protein sequences. Exceptional performance was observed in predicting crucial SARS-CoV-2 protein sequences via suggested model. Applying genome sequencing information obtained from the NCBI, present study demonstrated that genomic sequences were predicted with 98% accuracy, with no variation in protein sequences. Authors concluded that the proposed model was a significant advancement in phylogenetic analysis [13].

Verma and B. Rathi investigates the emergence of mucormycosis following COVID-19 recovery, employing machine learning and bioinformatics. Through text mining, crucial patient data such as demographics, symptoms, and treatment approaches are extracted. Utilizing this information, a disease model is developed to predict potential risk factors associated with post-COVID-19 mucormycosis. Additionally, a host-microbe interaction network is constructed to uncover candidate drug targets like R1A and biomarkers such as RPS6. These findings hold promise for improving prognosis, enabling early detection, and guiding treatment decisions for post-COVID-19 mucormycosis. However, further validation in clinical settings is essential to confirm the utility and effectiveness of these identified targets and biomarkers [18]. Zhu & Cai studied and explored the capacity of NN to forecast the appropriate topology and sequence evolution model for reconstructing PT from molecular data. The vital component of research is the creation of PT using the Maximum Likelihood approach. NN topologies were trained with nucleotide sequence alignments and amino acid sequence alignments, various evolution related models, features, and branch length as input for developing ML algorithm. Further, the study displayed that the NN classifiers were more efficient and quicker than IQ-Tree technique used for Maximum Likelihood process. Researchers concluded that the proposed ML have the ability to develop tree topologies more accurately than conventional Maximum Likelihood technique [19].

3 RESULTS AND DISCUSSIONS

Mucormycosis can have a higher death rate, if the symptoms are not identified and treated at the early stages. Fungus has the ability to induce tissue necrosis, which destroys the neighboring tissues and further spreads to vital organs inside human body. Phylogenetic analysis of many sequences is a key part in developing drugs against pathogens such as black fungus. Phylogenetic analysis plays a vital role in the process of repurposing drugs as a weapon against new pathogens. Conventional phylogenetic analysis is a time-consuming process. Hence there is a need to develop ML algorithm for performing phylogenetic analysis as discussed in Figure 1. ML techniques have the potential to be more advantageous than conventional phylogenetic methods in handling large-scale genetic data, mitigating noise, and increasing the precision of PT construction [7,17]. Literature review indicates research performed and limitations in the field phylogenetic analysis through ML. Present ML based PT construction is an expensive, time- consuming process, algorithm cannot handle sophisticated sequence analysis applications and requires significant data to produce best results. Other limitations are constraints with fixed input dimensions, big data classification is difficult process and occupies significant memory in system. Most common limitation is that the present algorithm cannot produce complex parsimonious tree. Overall, these limitations highlight the need for additional research and innovative methods in ML based construction of PT. Present paper discusses a robust ML framework for performing phylogenetic analysis large complex databases in a short period of time, which can be used as base for development of drugs against black fungus.

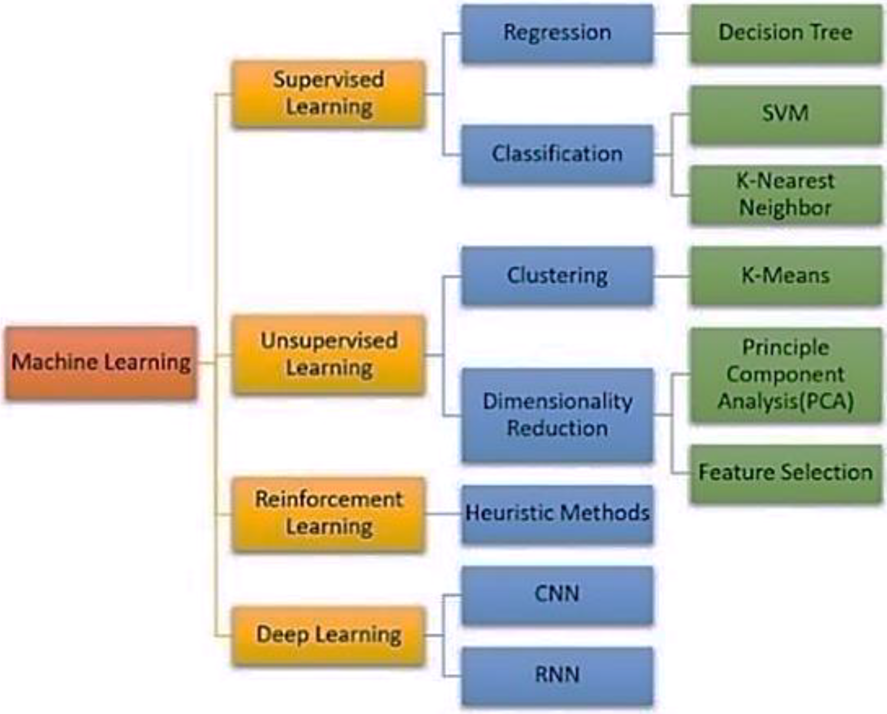

Figure 1. Types of ML algorithms used for phylogenetic analysis.

4 CONCLUSION

Phylogenetics provides important information on the genetic composition and evolutionary history of the fungus that causes mucormycosis. This knowledge is essential for creating efficient treatment plans, preventative actions, and possibly even novel medications or vaccinations to fight mucormycosis. In addition to helping to visualize the evolutionary history, the disease's genesis, patterns of transmission, and the appearance of new variants may all be determined using the tree. Phylogenetic analysis of many sequences is a key part in developing drugs against pathogens such as black fungus. Phylogenetic analysis plays a vital role in the process of repurposing drugs as a weapon against new pathogens. Conventional phylogenetic analysis is a time-consuming process. Hence there is a need to develop ML algorithm for performing phylogenetic analysis. Present ML based PT construction is an expensive, time-consuming process. Most common limitation is that the present algorithm cannot produce complex parsimonious tree. Present paper discusses ML framework for performing phylogenetic analysis of large databases in a short period of time, which can be used as base for repurposing drugs against black fungus.

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Molecular docking studies of selected target proteins of *Candida auris* employing machine learning (ML) methods

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ABSTRACT: *Candida auris* is a kind of fungus that causes severe illness in humans. *Candida auris* belongs to the Candida genus which is a group of infectious yeast species. Both enzymes Peptidyl-prolyl isomerases (PPIases) and Dihydrofolate Reductase (DHFR) plays an important role in life cycle of *Candida auris.* Inhibiting activity of both enzymes i.e. PPIases & DHFR disrupts the normal functioning of fungal cell and helps to fight against *Candida auris* infection. The fungus *Candida auris* infests on the skin cells and displays aversion to antifungal agents. Molecular docking is a conventional approach used for exploring chemicals as antifungal agents to fight against fungal infections. Exploring vast library of molecules through conventional drug discovery process to discover effective drugs against the resistant strains of fungus is a very difficult process. Hence, there is a need for alternative techniques such as ML to develop drugs against pathogens such as *Candida auris.* Identifying diseases caused by fungi is often challenging because the fungal pathogens may exist asymptomatically leading to difficulty in tracking the chain of spread, deficiency in availability of tools. *Candida auris is* one such disease-causing fungus that have been selected for present study. Hence, there is need to develop a robust ML algorithm to create user friendly environment to increase speed and quality of process of molecular docking.

Keywords: Candida auris, Molecular docking, Scoring function, Machine learning (ML), ML framework

1 INTRODUCTION

Candida auris is a kind of fungus that causes severe illness in humans. *Candida auris* belongs to the Candida genus which is a group of infectious yeast species. Fungus enters the human body through open wounds and ears causing symptoms similar to bacterial illness. Fungal infection has been observed in a number of regions and have the ability to convert into an epidemic due to the resistance of fungus towards antifungal agents. *Candida auris* displays numerous pathogenic features such as accumulation of digestive enzymes, biofilm genes and resistance towards the azole compounds. PPIases belong to the superfamily of molecular chaperons that isolates proline residues which carry out a variety of functions in protein folding along with enforcement [2,15]. DHFR, which is a crucial component within the folate process, DHFR protein that transforms Dihydrofolate (DHF) into Tetrahydrofolate (THF). Inhibiting the activity of both enzymes i.e. PPIases & DHFR disrupt the normal functioning of fungal cells and helps the human body to fight and recover from *Candida auris* infection. The action of antifungal agents against *Candida auris* show limited effectiveness [9]. Antimicrobial Resistance of cephalosporin was observed for the fungus *Candida auris.* Molecular docking is a conventional approach used for exploring chemicals as antifungal agents to fight against fungal infections. Exploring vast library of molecules through conventional drug discovery process to discover effective drugs against the resistant strains

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of fungus is a difficult, laborious, and time-consuming process [4,5]. ML assists to explore large library of chemical s containing phytocompounds such as, *Toddalia asiatica* [11,18], Ashwagandha [13], *Epiphyllum oxypetalum* [14] and *Coleonema album* [15], *Ocimum sp.* [16,23], *Pimenta dioica* [17,10] as a lead molecule for the treatment of black fungus. *Candida auris* was isolated for the first time from a patient's ear canal in Japan in 2009 [19]. Hence, there is a need for alternative techniques such as ML to develop drugs against pathogens such as *Candida auris.* ML approaches utilize inference and repetition of sequences to draw predictions and results instead of instructions. Different types of learning based on ML are employed such as Supervised, Unsupervised and Reinforcement Learning.

2 LITERATURE SURVEY

DFT calculations level were employed to maximise the compounds geometrical characteristics. Analysis of vibrational frequency was employed to investigate the structures of certain compounds like 2-FBC and 4-FBC. Through a comparative analysis of theoretical and experimental vibrational frequencies, the research offers significant understanding of the properties of various chemical bonds found in these molecules. Additionally, the NMR research looked at the structural properties of the substances under investigation and further identified the hydrogen habitats [1]. Crampon *et al.* (2022) have discussed about application of DL and ML for solving molecular docking problems. Three obstacles were identified by the researchers and they were computational time required, scoring function and sampling data. Authors understood from literature survey that no ML method was analyzed to tackle sampling problem. Authors concluded that ML can be applied in combination with experimental knowledge to produce more effective drugs [3].

Lee *et al* (2023) have demonstrated the latest advanced state of GPCR interaction in conjunction with newly predicted protein structures based on DL. Objective of study was to display the application of updated version of Dl simulation for molecular docking process. Results demonstrated that comparative analysis between best pre-DL and TBM modelling. From results, the team concluded that the application of DL-based modelling was more suited for docking or screening GPCRs [7]. Li *et al*, (2021) used phylogenetic studies to determine the *Candida auris* strain pattern and classify it into clade III. Application of ML holds immense potential in analyzing complex data sets and categorize drug-resistant strains using WGS statistics, which is crucial for anticipating mutations linked to the cases of drug resistance. From the outcomes of designed framework's authors concluded that ML classifiers showed significant performance during drug testing process. ML model performed well for echinocandins and azoles [8]. Sunuwar *et al.* (2022) have studied infectious bacterial agents that show resistance to drugs and have utilized the concept of ML in decoding gene elements connected to antibacterial resistance of bacterial species towards different drugs. Authors have applied unbiased whole genome approach to analyze all protein-coding genes present in the target genome. They have explored the potential of ML in uncovering new hidden genes and output was reinforced using experiments based on computational docking [20].

The K143R and Y132F mutants of the system expressing *Saccharomyces cerevisiae* with background drug efflux pumps, CauCdr1-the ABC transporter, CauMdr1-the drug efflux pump belonging to MFS, and CauErg11-the recombinant azole target were all functionally overexpressed. CauErg11-the azole drug target, a crucial component of biosynthesis of sterols, the primary target-based mutations (CauErg11 K143R and Y132F), and the drug efflux pumps dependent on CauCdr1 and CauMdr1 contribute to azole resistance in *Candida auris were* all characterised using this approach in a host that displayed hypersensitivity towards azole drugs. The findings of the study gave crucial instruments needed for biochemical and phenotypic screenings of the crucial targets influencing resistance or susceptibility towards azole. Conclusion revealed that this platform is not applicable in case of high expression level proteins [21]. Intermolecular interactions between DNA and intercalating agents were described, and an ML model capable of predicting experimental values of ΔTm was constructed. When DOCK 6 and AutoDock Vina were coupled and the MolAr CVS method was applied, the combined results were better than the individual results obtained from each tool. The combination of AUC-ROC, BedROC, and EF measurements demonstrated its ability to produce more accurate ligand conformation prediction results [22].

3 RESULT AND DISCUSSION

Candida auris is a type of fungus that causes severe illness in the human body. The target proteins and ligands studied to antifungal agents against *Candida auris* displaying multidrug-resistant properties. PPIases isolates proline residues that plays vital role in the process of protein folding. DHFR aids in transformation of Dihydrofolate (DHF) into Tetrahydrofolate (THF). Inhibiting the activity of both enzymes i.e. PPIases & DHFR disrupts the normal functioning of fungal cell and helps the human body to fight and recover from *Candida auris* infection (Table 1) [3]. Molecular docking is a conventional approach used for exploring chemicals as antifungal agents to fight against fungal infections. Exploring vast library of molecules through conventional drug discovery process to discover effective drugs against the resistant strains of fungus is a very difficult, laborious and time-consuming process. Pandemic also plays an important role in increasing the probability of the occurrence of fungal infections [6,10]. Hence, there is a need for alternative techniques such as ML to develop drugs against pathogens such as *Candida auris*. ML promises to provide time efficient methods that can ease the process with maximum accuracy. Various environmental disturbances encountered in traditional methods can be overlooked in these ML based methods [11,12,24]. Identifying diseases caused by fungi is often challenging because the fungal pathogens may exist asymptomatically leading to difficulty in tracking the transmission and due to lack of available tools. *Candida auris* is one such disease-causing fungus that have been selected for present study.

Table 1. Target protein and ligand combinations.

S. No	Protein	Group	Ligand	Group
1	Dihydrofolate reductase	DHFR	Quercetin	Flavonoids
2	Peptidylprolyl isomerase	Cyclophilin	Lupeol	Pentacyclic Triterpenoid

4 CONCLUSION

Exploring vast library of molecules through conventional drug discovery process to discover effective drugs against the resistant strains of fungus is a very difficult, process. Hence, there is a need for alternative techniques such as ML to develop drugs against pathogens such as *Candida auris.* Identifying diseases caused by fungi is often challenging because the fungal pathogens may exist asymptomatically leading to difficulty in tracking disease transmission. *Candida auris* is one such disease-causing fungus that have been selected for present study. Hence, there is need to develop a robust ML algorithm to increase speed and quality of molecular docking process and results respectively.

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A survey on machine learning inspired healthcare informatics studies of COVID-19 disease

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ABSTRACT: Major symptoms displayed by COVID-19 disease infected patients were found similar to common seasonal flu symptoms. The available detection tools used in the identification of COVID-19 positive cases were of time-consuming methods and sometimes produced false positive results. Therefore, development of supporting tools required for analysing patients infected with COVID-19 disease is of prime importance, hence the analysis of both the CT scan and the X-Ray images that can be utilized efficiently in detecting the positive cases of Covid 19. Recent research studies have proven that chest related X-ray images could explore the useful information related to the infection caused by COVID-19 virus. With the objective, present survey briefly explains the use of images obtained via X-ray in predicting infected COVID-19 cases employing Artificial Intelligence (AI) based ML approaches such as CNN (Convolutional Neural Network) and the SVM (Support Vector Machine) techniques. Latest information collected on AI-ML techniques used for COVID-19 detection was critically analysed to determine the best AI-ML method to be employed for obtaining precise identification and the diagnosis of COVID-19 disease and for the similar viral pandemics expected in the near future studying chest related x-ray images.

Keywords: COVID-19, Chest X-ray, Machine Learning (ML), SVM, CNN

1 INTRODUCTION

The infection of a novel corona virus known as SARS-CoV-2 led to the rapid global spread of a dangerous infectious disease named COVID-19. Symptoms of COVID-19 observed in infected person were mainly fever, cough, fatigue and difficulty in breathing. COVID-19 is the pandemic that had caused profound impact on the world, with far-reaching effects on health, education, travel, social life, and mental health of individuals. The pandemic has infected millions of people thus leadings to deaths of many individuals on a global scale. On the other hand, the pandemic has spurred a global scientific effort to understand the virus and develop effective vaccines and treatment regimes for fighting pandemic. This had led to unparalleled collaboration and innovation in the scientific community. COVID-19 has proved that AI (Artificial Intelligence) and the ML (Machine Learning) could be effectively used in health care sector. Hence it is important to implement new techniques such as AI and ML techniques to fight against infectious diseases. ML is a field of AI that involves designing and training models to analyse and make predictions based on patterns obtained from input data. Three main types of ML methods are unsupervised learning, reinforcement learning and supervised learning [5]. Data essentially required for drug discovery is related to the physiochemical properties of Phytocompounds. Unsupervised learning involves training the algorithm on unlabelled data, without any predefined output. Reinforcement learning learns by interacting with an environment and taking actions that produces maximum rewards [6]. Supervised learning is the most common type of machine learning, ex-are linear regression, logistic regression, decision tree, SVM etc. Most popular supervised learning technique used

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in detection of COVID-19 disease were SVM and CNN [5,7]. SVM algorithm can solve issues involving both regression and classification problems. SVM creates a best decision boundary called as hyperplane that filters n-dimensional into classes which can be helpful in putting the new data point into the right class. By analysing above parameters, such as cough with sputum, high fever, and shortness of breath it is possible to differentiate individuals infected with COVID-19 from the health population applying SVM [7,9]. CNN Refers to ANN which is based on principle of convolution, consists of multiple hidden convolution layers along with an input layer [10]. These layers aren't visible to the external systems as they are in between the output and input layers. Therefore, these layers are called as hidden layers. General CNN architecture used for COVID-19 detection [18].

2 LITERATURE STUDY

Hayat *et al.* (2023) conducted study on analysis of coronavirus with systematic use Deep learning (DL) techniques using medical imaging methods. Study analysed 17,599 images used as input for developing ML model using SVM, CNN and logistic regression studies for classifying COVID-19 infection. Authors used python-based architecture named SCovNet that have provided accurate results for COVID-19 detection. Study concluded that DL models provide better detection results in comparison to conventional ML models [1]. Majhi and Paul (2023) discussed the applications of AI-ML for combating against COVID-19 disease and conducted a systematic study on the utilization of the images obtained from CT scan and the X-Ray for the purpose of COVID-19 detection. Study identified that in the literature Data mining was performed using parameters such as language, subject field, publication stage, and source type to remove unwanted data from total data. Study concluded that the use of AI ML in COVID-19 detection was found to be efficient, particularly in analysing X-rays and CT scans images [10]. Kurt *et al.* (2023) studied the diagnosis of COVID-19 disease using k-means algorithm. Proposed system is based on Lung region segmentation using k-means, four pre-trained EfficientNet models and performance evaluation based on statistical measures. 9729 lung parenchymal samples known as "Turkish Covid-19," a unique dataset derived from patient CT data from the Bursa Yüksek Ihtisas Education, were used by the authors of this study. Further, they divided this dataset into 20% testing and 80% training set. Authors observed that classification accuracy obtained from various ML models i.e. 97.60, 98.84% and 99.64% [2]. Avcı and Alzabaq (2022) discussed different AI and ML models used in detection of COVID-19. Study assessed research performed by various authors and indicates that great quantity of research has been performed for the identification of COVID-19 by utilizing some new AI and ML technique. Authors analysed the data studying different ML models such as CNN, VGG16, kNN, DL, decision tree, and ResNet50 models with their accuracy levels in detecting COVID-19 disease. On average 92% accuracy was given by CNN and concluded that CNN is comparatively a better model used for recognizing COVID-19 in comparison with the ML model [3]. Bhatele *et al.* (2022) conducted a study on the utilization of ultrasound, CT, and chest X-ray images along with deep learning approaches to diagnose the disease COVID-19. Research focused on analysing chest X-rays, Ultrasound images and CT scan and discovered research lacunae for future research work. Study discussed about various challenges and limitations with respect to the deep learning approaches that were efficiently utilized for detection of COVID-19. Study envisaged the need of further research for differentiating COVID-19 cases from common pneumonia cases from larger datasets. It is evidenced from the study that the hybrid models that combines deep learning architectures with machine learning classifiers, can produce better results for binary or multiclass classification of COVID-19 disease [4]. Rezayi *et al.* (2022) conferred major roles played by AL-ML techniques in COVID-19 analysis. Study discussed about devastating effects of virus on both economy and human life on a global scale. Study conducted a thorough review on 60 research papers containing data about AI-ML techniques that were applied to perform study of COVID-19 used the methodical search on PRISMAs. These were performed to analyse different AI ML techniques used in COVID-19 detection. Authors have concluded that AI ML methods such as VGG 19, DenseNet, VGG 16, ResNet101 and SVM that were used for C0VID-19 analysis reported high precision results [12].

Mulrenan *et al.* (2022) performed a study on application of images obtained from X-Ray and CT scan to detect COVID-19. Study found that more than 291 million COVID-19 cases were recorded worldwide on January 2022. Hence, there is a definite need for alternate methods like medical imaging i.e. X-ray and CT scan images for early detection of infected cases. These methods can also provide fast and accurate diagnosis of individuals suspected with COVID-19 infection. Study stressed about the harmful effects of higher radiation doses used on human body for performing CT scans. Hence authors performed data mining using the deep learning techniques with images of chest X-Ray or CT scan as keywords which were used to prepare a database containing higher than 100 confirmed cases of COVID-19 with improved values of AUC, specificity and sensitivity. Study used modified version of TRIPOD framework to assess the quality of assessed data in all the selected areas such as purpose, data source, participant details, statistical analysis, model (development, performance, validation, and limitations) and study funding. Further study analysed literature published to detect COVID-19 using AI techniques through images of CT scan and chest X-Rays as the input. These studies demonstrate that deep learning techniques have possibility of providing computerised diagnosis of COVID-19 using different modes. The study arrived to the result that in order to improve the chances of using novel AI systems in areas where patients will benefit more, future research should concentrate on including pertinent diagnostic comparisons and external validation [13].

3 RESEARCH IMPORTANCE

Evidenced from the critical survey that, there are not many large and well-maintained databases to retrieve the patient information data related to the infection and spread of the COVID-19 disease. Insufficient data makes the algorithms used for predicting COVID-19 [16,17] detection less prominent and efficient. Existing literature proofed the non-availability of hybrid data sets to detect COVID-19 disease. Present study suggested to explore different types of the data related to the COVID-19 disease detection and the exploration of novel hybrid algorithms to analyse the data effectively to detect the COVID 19 cases with high accuracy and sensitivity.

4 PROPOSED MODEL FOR THE COVID-19 DETECTION USING ML ALGORITHMS

Images of chest x-ray obtained in the different formats such as AP, PA and lateral view of COVID-19 and healthy patients were collected from various hospitals and service centres. Quality of chest radiogram images was determined with reinforced learning ML algorithm. Based on quality analysis results, total population of radiographs was segregated into low and high-quality images. After segregation, low quality images were converted into high quality images by increasing the image resolution through CNN algorithm. After enhancing the quality of images, they were used for building COVID-19 chest x-ray database. Chest x-ray images present in database were further classified as COVID-19 infected and COVID-19 non-infected chest radiogram images which was further classified as learning and evaluation data. Both training and testing set was used for designing and testing SVM algorithm for COVID-19 detection. Accuracy of the SVM algorithm was detected and false positive results was eliminated using VGG algorithm. Designed algorithm was converted into software for user friendly platform for performing COVID-19 detection (Figure 1).

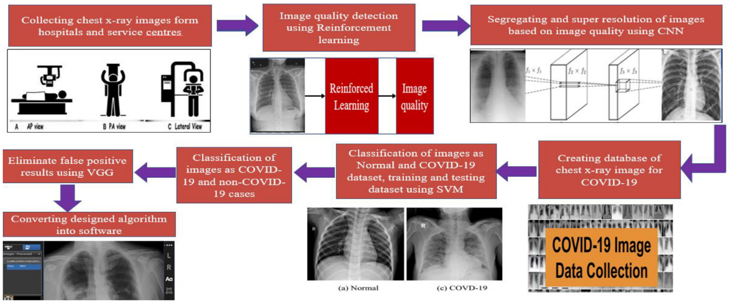
Collecting chest x-ray images form hospitals and service centres
A AP view
B PA view
C Lateral View
Image quality detection using Reinforcement learning
Reinforced Learning
Image quality
Segregating and super resolution of images based on image quality using CNN
Creating database of chest x-ray image for COVID-19
COVID-19 Image Data Collection
Classification of images as Normal and COVID-19 dataset, training and testing dataset using SVM
(a) Normal
(c) COVD-19
Classification of images as COVID-19 and non-COVID-19 cases
Eliminate false positive results using VGG
Converting designed algorithm into software

Figure 1. Protocol applied for COVID-19 detection through chest radiogram images [14].

5 RESULT AND DISCUSSION

From the detailed survey present research suggest creation of large-scale database like "GenBank", "NCBI" that will be specific for a disease/virus. Such databases require huge amount of data from hospitals all over the world. With the help of a consent form filled by patients or their family, doctors can upload data such as CT scan or angiogram images on these databases for further analysis [8,10]. Data uploaded by medical staff can be utilized by researchers and pharmaceuticals in developing vaccine or diagnostic tool for early detection of COVID-19 [11,15] or viral pandemics. Second, the quality of graphical data can be increased by designing new software's. Such software's aids in uploading high quality data and in turn helps in research process. Application of mixed or hybrid techniques can be applied in efficient detection of COVID-19 and other diseases [19,20]. This can greatly improve the detection rate and also decrease the false results. Proposed model helps to overcome above mentioned research gaps for the COVID-19 detection. Chest radiogram images collected from hospitals were processed through quality analysis using reinforcement learning. Quality of chest radiogram images were enhanced using super resolution process of CNN algorithm. This process helps to enhance the distinction and proportion of the chest radiograph images that were used for analysis of COVID-19. Chest x-ray images retrieved were segregated as normal, COVID-19, training and testing dataset using SVM algorithm. SVM algorithm was trained using reference dataset and designed algorithm was tested using testing dataset. Final algorithm was converted into software for providing user friendly platform for performing COVID-19 detection through chest x-ray images.

6 CONCLUSION

Present research provided a survey on of recent studies focusing on the application of ML techniques using CT-Scan and X-ray images to aid medical experts in accurate prognosis of COVID-19 disease. Study emphasizes the importance of quality attributes in clinical methods for diagnosing the infected individuals. Study critically inferred that among the diverse ML methods enrolled in COVID 19 disease detection, CNN based DL methods found be more accurate and sensitive. The growing number of articles in this area indicates the high success rate of these techniques in disease diagnosis. Consequently, these techniques will play a significant role in the future for early detection and prevention of viral outbreaks.

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Combination of machine learning and computational vaccine discovery to develop multi-epitope vaccine against viral diseases (Dengue virus (DENV))

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ABSTRACT: Dengue virus poses a significant global health challenge, necessitating a deeper understanding and innovative therapeutic interventions. The present study proposes a novel computational approach employing Machine Learning (ML) to enhance the efficiency of conventional vaccine discovery processes. Approximately 1.3 billion individuals residing in Southeast Asia (SEA) are at risk of contracting dengue virus infection. Notably, five SEA nations (Indonesia, Burma, Sri Lanka, Thailand, and India) are among the top 30 most highly endemic countries worldwide. Over time, the number of dengue cases has increased significantly, despite efforts to control the disease. Between 2015 and 2019, the SEA Region witnessed a 46% increase in dengue cases, while dengue-related deaths decreased by 2%. Several factors contribute to the spread and distribution of dengue mosquito vectors and viruses in the SEA Region. The current high burden of dengue cases in the SEA Region is exacerbated by the lack of effective treatments and sustainable vector control measures. The objective is to identify and develop a multi-epitope vaccine as a weapon against antigenic proteins of DENV3. The traditional vaccine development process is very time-consuming. By employing an in-silico (computational) vaccine discovery approach integrated with machine learning (ML) algorithms like artificial neural networks (ANN), random forest (RF), and decision trees, the time and need for resources is drastically reduced. These ML models can be trained on experimental data to aid in the design of multi-epitope vaccine to combat the DENV3 dengue virus serotype.

Keywords: DENV, Southeast Asia, Multi-drug resistance, Conventional Vaccine Discovery, ML framework

1 INTRODUCTION

Dengue virus (DENV) belongs to the Flaviviridae family of viruses. Humans typically contract dengue through bites from infected Aedes aegypti mosquitoes. Dengue fever symptoms can range from mild flu-like illness to the potentially fatal dengue hemorrhagic fever. The World Health Organization (WHO) aims to reduce dengue morbidity by at least 25% and mortality by 50%, and to develop a safe, affordable and effective vaccine against the four dengue serotypes (DENV-1, DENV-2, DENV-3, and DENV-4) which is becoming increasingly crucial for public health. Immunity against one serotype does not confer protection against the other three. This study focuses on DENV-3 serotype due to its high prevalence and rapid spread in Southeast Asia (SEA). Non-structural proteins like NS1, NS2A, NS2B, NS3, NS4A, NS4B and NS5 are explored as potential antigenic targets for dengue vaccine development [1]. NS1 is a glycoprotein that has an important role in the life cycle of DENV. It is found in membrane-associated form and secreted in the bloodstream,

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and it is used as a biomarker when detected in the bloodstream. NS2A participates in viral replication and particle assembly. Viral protease NS3 has NS2B as a cofactor for cleaving proteins and replicating RNA i.e., proteolytic activity. The NS3 protein is a multifunctional molecule consisting of two major domains: protease and RNA helicase. Protease is responsible for slicing viral polypeptides into functional proteins. Helicase domain function is responsible for replicating viral RNA molecules. NS4A and NS4B contribute to replication complex formation and immune evasion [2]. NS4B and NS5 is essential for the replication of viral RNA. Establishing the replication complex and duplicating viral RNA are crucial steps facilitated by these non-structural proteins. It is made up of two domains: methyltransferase domain that changes the caps of viral RNA to dodge host immune response, and RNA-dependent RNA polymerase (RdRp) domain that synthesises viral RNA. These NSP are essential for replication and survival of DENV within host cells. Different phytocompound isolated from different medicinal plants such as ashwagandha [3], *Epiphyllum oxypetalum* [4], *Curcuma longa Linn* [5], fungal isolates [6], *Coleonema album* [7], *Toddalia asiatica* [8] and *Ocimum* [9] can be explored to identify potential lead candidates against Dengue serotypes to control the symptoms of disease until the discovery of vaccine.

Hence there is a need for development of efficient vaccine to combat against DENV serotypes. Understanding their functions and integrating ML algorithms is critical for developing potential multi-epitope vaccine against DENV3. Conventional vaccine discovery process is a time-consuming process. Hence ML algorithms plays a crucial role in accelerating vaccine discovery process. Various ML algorithms useful for designing multi-epitope vaccine are listed below (Figure 2):

- Support Vector Machine (SVM): SVM is applied to accomplish classification and regression tasks.
- Neural Network (NN): Made up of interconnected nodes, that works to solve complex problems.
- Decision Tree: Type of SVM that uses binary tree graph to assign target values to the sample data.
- Convolutional Neural Network (CNN): CNN self-learns local features used for image analysis [10].

Hence there is need to develop multi-epitope vaccine using immunoinformatics integrated with ML to develop ML framework to design safe and effective vaccine against DENV3.

2 LITERATURE REVIEW

Literature review presents an overview of various methodologies employed in recent research endeavors aimed at vaccine development against different viruses, particularly focusing on Nipah virus (NPV), SARS-CoV-2, and Dengue virus (DENV). Dhiman Sarma (2020) introduced a data-driven approach utilizing machine learning algorithms for modeling dengue cases based on historical and environmental data. While offering predictive insights, challenges related to data quality and pre-processing complexity were acknowledged [11]. Fadaka (2021) proposed a multi-epitope vaccine against DENV utilizing a reverse vaccinology approach and computational techniques. The identified vaccine candidates exhibited favorable binding interactions with immune receptors, suggesting potential efficacy, pending in vitro and in vivo validation [12]. Khan (2022) endorsed epitope-based subunit vaccines by predicting MHC binding affinity and B-cell epitopes for DENV. The need for more experimental validation was also highlighted [13].

Mamuna Mukhtar (2022) detailed the use of immunoinformatics tools for precise antigen selection, particularly in mRNA vaccine design for DENV, with the aim for reducing allergenic responses [14]. Mohammadi *et al.* (2024) used machine learning (ML) to design vaccine structures against SARS-Cov-2 while focusing on: cytotoxic T lymphocyte (CTL) and helper T lymphocyte (HTL) epitopes. This approach leads to the selection of candidate constructs which exhibits promising immune simulation properties and high production yields [15]. Samuel Santos Pereira (2023) discussed the construction of multi-epitope antigens for DENV diagnosis. While offering improved diagnostic accuracy, limitations such as cross-reactivity and incomplete serotype coverage were noted [16]. Shahab et al. (2024) highlighted the absence of vaccines against NPV and introduced a strategy employing immunoinformatics to design vaccine candidates stimulating both B and T cells. They identified novel epitopes and confirmed stable interactions with human immune receptors through docking and molecular dynamics simulations [17]. Overall studies demonstrated diverse approaches leveraging computational techniques and ML alongside traditional methods in vaccine development, underscoring the importance of interdisciplinary strategies in addressing global health challenges.

3 PROPOSED METHODOLOGY

In order to overcome these challenges, there is a need for ML framework containing ML algorithms to accelerate the process of vaccine discovering process for dengue virus. Present study proposes a ML framework containing different ML algorithms that can enhance vaccine discovery process and they are:

- SVM algorithm to predict epitopes for antigenic proteins of DENV3 [18].
- Neural Networks, Decision Trees, and Linear Regression algorithms to analyze epitope properties.
- CNN to design vaccine sequence & structure and dock the designed vaccine with target antigen (Figure 1) [19].

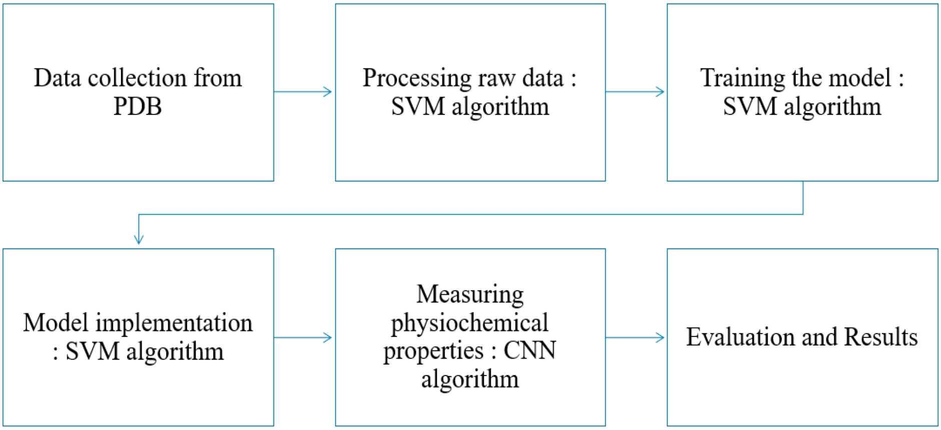
Data collection from PDB
Processing raw data : SVM algorithm
Training the model : SVM algorithm
Model implementation : SVM algorithm
Measuring physiochemical properties : CNN algorithm
Evaluation and Results

Figure 1. Machine learning framework proposed for vaccine development.

4 RESULTS AND DISCUSSIONS

DENV is the pathogenic member of the family named as Flaviviridae and is classified as four different serotypes (i.e. DENV1 to DENV4), and natural or acquired immunity obtained against any one serotype does not confer immunity against remaining three serotypes of DENV. Present study concentrates on serotype DENV-3, due to its widespread infection in SEA. Conventional vaccine discovery is a time-consuming process and less suitable during viral outbreaks because it cannot deliver vaccine in a short period to prevent spread of viral outbreak. Hence there is a need to incorporate ML to accomplish different steps present in conventional vaccine discovery process against DENV. Literature review revealed the potential research gaps in the domain such as [20]:

- Limited historical data on dengue cases may impact model accuracy.
- Missing values, noise in data need to be handled.
- Relationships between predictors and dengue incidence may change over time.
- Requires re-training models periodically.

Dengue can be episodic leading to imbalanced data where outbreaks pose modeling challenges. ML framework proposed for the development of multi-epitope vaccine against DENV can yield PDB file of antibody multi-epitope complex (Figure 2) along with docking score as results. These results can help in the development of multi-epitope vaccine against DENV.

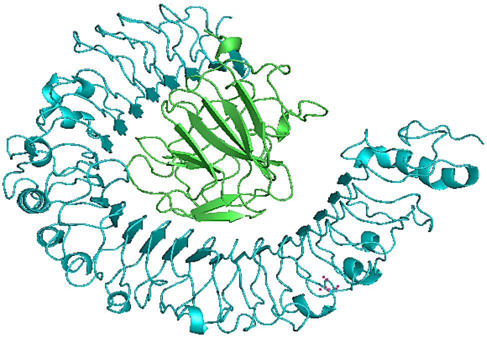

Figure 2. Antibody multi-epitope vaccine complex.

5 CONCLUSION

DENV3 is a serious threat in SEA and resistance of virus towards many drugs make it difficult for the development of permanent cure for DENV3. Developing a multi vaccine helps to combat with DENV3. Conventional vaccine formulation process is both laborious and requires longer time duration for formulation and synthesis, hence it cannot be applied during the period of viral outbreaks. Integrating ML with conventional vaccine development process helps to explore different combinations of vaccine and further design an effective and safe vaccine against dengue virus. From literature review it was evident that there is need for ML framework containing ML algorithms for each step of conventional vaccine discovery process. Hence, present study proposes a ML framework comprising of different ML algorithms that can enhance vaccine discovery process against antigenic proteins of DENV3.

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The role of machine learning in drug repurposing

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ABSTRACT: The development of new drugs is a lengthy and resource-intensive process, often spanning decades and requiring substantial financial investment and effort. With success rates typically low, hovering around 14%, the need to streamline this process, reduce costs, and enhance success rates is paramount. Drug repurposing emerges as a crucial strategy to achieve these goals by identifying novel therapeutic indications for existing drugs. Also known as drug repositioning or therapeutic switching, this approach leverages previous investments while mitigating the risks associated with clinical activities. Compared to traditional drug discovery methods, which are characterized by their high expenses, laborious nature, and significant risk of failure, drug repurposing offers a more efficient alternative. This review explores how leveraging machine learning techniques in drug repurposing can further expedite the drug development process while minimizing costs. By harnessing the power of computational algorithms, researchers can efficiently sift through vast datasets to identify promising candidates for repurposing, ultimately accelerating the delivery of new therapeutic solutions.

Keywords: Machine Learning, Drug Repurposing, Clinical, Covid-19

1 INTRODUCTION

Drug discovery process is an expensive and the time-taking task. Significant investment is necessary during the early stages of regulatory development, before the clinical phase, up until the drug receives approval for market release from regulatory agencies. Consequently, drug repurposing has become increasingly prevalent in recent years to accelerate the drug discovery process [1].

Drug repurposing also called as drug repositioning is the process in which already approved or investigational drug is identified for any new pharmaceutical activity. Over developing of totally new molecular moiety this process has various advantages are less risk to failure of the compound as the drug repurposed is already have been found safe in preclinical models and humans and it is very less likely to fail at least at safety margin. Since

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most preclinical research, safety measurements, and in some cases formulation developments have already been completed, the development time can be shortened.

Less money is needed to be expended [3]. Drug repurposing can be called as the economic process to re-use the approved drugs for new pharmaceutical activity [7]. Drug repurposing involves more than just finding new uses for outdated medications; it also considers several other factors, such as the disease's relevance and the tolerability of side effects for the new usage [1]. Experimental screening approaches and in silico approaches are the approaches on which the repurposing approaches are based for the identification of new drug-disease associations. Drug repurposing with different applications and outcomes is achieved through the use of experimental screening procedures. And in-silico repurposing approaches allow the use of advanced analytical technique to the existing data to identify new drug disease association [4]. In the case of rare diseases and pandemics (COVID-19, Ebola virus etc.), which mainly has impact either on large population or on low-income population pharma companies cannot afford this large investment and such a long-time frame of 12–15 years. In such circumstances, repurposing already approved drugs within safe limits offers an alternative avenue to urgently address the need for therapeutic treatment [2].

1.2 *Examples of the marketed repurposed drugs*

Recently there are various drugs that are repurposed and are marketed all over the world. These drugs are all repurposed using different ML based techniques like molecular docking deep learning and used various AI based models to make work easier more effective and, in less time. The veterinary antheminthic drug moxidectin has been presently repurposed for the management of onchocerciasis by using ML and molecular docking studies [5]. Benzbromarone is a highly effective uricosuric agent, used for treatment of gout since 1969. Further studies concluded that it has a property of *Staphylococcus aureus* inhibitor. Mometasone furoate used as anti-inflammatory corticosteroid, further found that it blocks multi-drug resistance protein-1 inhibitor (dose about 1000 times higher than used for allergic rhinitis).

Astemizole used as potent 2nd generation antihistamine drug, under trade name Hismanal later it was found that the drug can be used as prostate cancer cell killing. Tolfenamic acid used as NSAID related to mafenamic acid since 1976 under Clortam, not approved by FDA is recently identified as competitive inhibitor of binding of pathogenic hantavirus to dacay accelerating factor. Phenothiazines derivatives used as anti-malarial, anti-helminthics, anti-histaminics, sedatives and antipsychotics.

Currently phenothiazines has a possibility to be used as in treatment of Parkinson, Alzheimer, and as anti-bacterial and anti-fungal compound [14]. The DRIAD technology was employed to profile 80 compounds, primarily kinase inhibitors known for their anti-cancer activity. Among 80, 33 were FDA approved and remaining 33 consist of preclinical and 14 investigational compounds. MOAs of compounds were ranked and based on that disease severity was identified. Various drugs were identified whose targets are JAK kinases. Using DRIAD drugs can be identified that can mimic disease and inhibits it. It was found using drug repurposing that these drugs can also be used to promote neuronal cell death and can be used in Alzheimer's disease [13]. ML techniques were utilized to gather data on 1105 drugs used for COVID-19, focusing on cell responses to 372 mechanisms of action (MOAs).

Information on the mechanisms of action (MOAs) of drugs was gathered from the LINCS database. If five or more drugs exhibited the same MOA, it was recorded. The predominant MOA observed was adrenergic receptor antagonism, which was shared by 43 distinct drugs [3]. Hydralazine is used as smooth muscle relaxants and vasodilator against hypertension and heart failure and repurposed for the use in cancer patient as it act as de-methylating agents inhibits DNA methyltransferase. Metformin is an anti-diabetic drug used for type 2 diabetes was repurposed to use in colon cancer. Niclosamide is an anthelmintic drug and it is repurposed to use in prostate and colorectal cancer. Chloroquine is used to treat malaria repurposed as anti-cancer. Itraconazole used as antifungal interfere with ergosterol (sterol in fungal membrane) synthesis. It even has a direct effect on cancer cells [6].

2 LITERATURE SURVEY

Tetteh Cyril *et al.*; 2023 [5]: 58 test drugs were used out of which by using about five ML models 14 drugs were predicted that can be used for the treatment of onchocerciasis. Combination of exploratory data analysis, ML, and molecular docking studies. Han Lu *et al.*; 2021 [3]: Drug repurposing accelerated for the treatment of COVID-19. For the determination of mechanism of action, machine learning methods used. LINCS database. Opera T.I. and Mestres .J, 2012 [1]: Drug repurposing of drug for finding new targets for the old existing drugs as due the various side effects observed from the already existing target. Anderson Edward *et al.*; 2020 [10]: Drug repurposing for Chordoma which is a rare cancer that affects one individual in one million with no approved medication. To speed up for the medication of chordoma drug repurposing can be useful. Bayesian ML modelTanoli Ziaurrehman *et al.*; 2021 [7]: Drug repurposing for cancer. Include drug repurposing for three level of prediction tasks: For new drug-target interaction prediction of biochemical activity.

Response prediction for cell-based compounds. Predictions of drug repurposing by new drug-disease relationships. Above prediction are important for understanding the MOA of drug repurposed. Use of supervised ML and AI models, with accompanying data resources. Patel. N Chirag, *et al.*; 2023 [11]: Drug repurposing for the new targets for monkeypox virus. Monkeypox virus with lack of suitable medical therapy or vaccine has led to worsening of situation so in this article the study deals with the proposal of multi-step in silico pipeline to identify the inhibitors targeting the monkeypox. Use of AI based deep repurpose framework and molecular docking. Mall Raghvendra *et al.*, [8]: Drug repurposing for COVID-19. Since the extremely long and expensive de novo method of drug discovery requires a lot efforts so drug repurposing implemented. Use of ML representation framework that use deep learning induced vector embedding of drug and viral protein ton predict drug drug-viral promtein activity.Vatansever Sezen *et al.*; 2020 [9]: Drug repurposing using AI and ML in central nervous system diseases. ML and AI methods have improved the drug discovery process.

Use of AL/MI based models.Rodriguez Steve *et al.*; 2021 [13]: Drug repurposing for Alzheimer's disease can be facilitated through ML techniques, such as the DRIAD framework. DRIAD offers a powerful approach to evaluate potential relationships between the disease and various biological processes represented by lists of genes. It can effectively identify drugs that mimic the disease's biological processes as well as those that inhibit them, providing valuable insights into potential therapeutic options for Alzheimer's disease. Use of DRIAD (drug repurposing in Alzheimer) a ML framework. Issa Naiem T *et al.*; 2021, [12]: Drug repurposing for cancer. Artificial learning and ML approaches are accompanied along with advanced omics which can be helpful in target identification and pathway determination. Structure based ML Utilizing ML for molecular docking, ligand-based cheminformatics modelling, proteochemometrics modelling.

3 METHODOLOGIES

Figure 1 represents the methodology of survey in which research articles from various years are reviewed based on drug repurposing using ML technique. This gives the idea about how the AI and ML based models are applied and utilized for repurposing of drugs. The process begins with a comprehensive review of research articles spanning various years.

This step ensures that a wide range of studies are considered, providing a holistic understanding of the landscape of drug repurposing efforts. Relevant data from the selected articles are collected and analysed. This may include information on the drugs being repurposed, the target diseases, the ML algorithms or techniques employed, and the outcomes achieved.ML models are developed and tailored to the specific task of drug repurposing.

These models utilize advanced algorithms to analyse large datasets and identify potential candidate drugs for repurposing based on various criteria such as molecular structure, biological activity, and clinical data. The performance of the ML models is validated and evaluated using appropriate metrics. This step ensures the reliability and effectiveness of the models in identifying promising drug candidates for repurposing. The methodology may involve iterative refinement of the ML models based on feedback from validation and evaluation results. This iterative process helps improve the accuracy and reliability of the models over time.

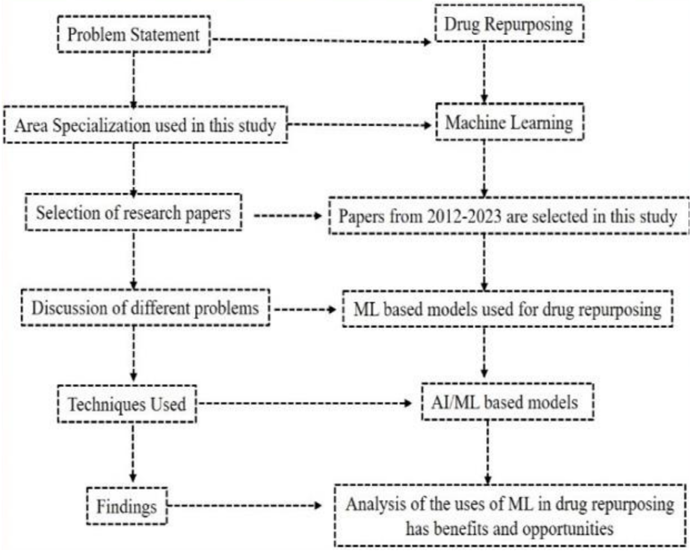
Problem Statement
Drug Repurposing
Area Specialization used in this study
Machine Learning
Selection of research papers
Papers from 2012-2023 are selected in this study
Discussion of different problems
ML based models used for drug repurposing
Techniques Used
AI/ML based models
Findings
Analysis of the uses of ML in drug repurposing has benefits and opportunities

Figure 1. Methodology of the survey.

4 CONCLUSIONS

Drug repurposing is the identification of new target or new therapeutic purpose for the already existing drug. Drug repurposing offer various advances over the de novo synthesis of the new molecular moiety. The article holds brief information along with examples about various repurposed drug that are used for treatment of various diseases and the MOA that the drugs follow. It contains information about the repurposing of the drugs using the ML tools and models that are making the work much easier and more economic. There are numerous drugs available that are repurposed in which some are FDA approved and some are not for example- Benzbromarone, Astemizole, Tolfenamic acid, Phenothiazines, hydralazine, metformin etc. these drugs are basically repurposed using various ML and molecular docking techniques. These ML techniques are also helpful for determination of MOAs and target identification of various drugs. AI and ML techniques contributes to treatment of various diseases like cancer, onchocerciasis, COVID-19 etc. by drug repurposing. Drug repurposing using AI is the time saving process with less chances of failure. But these methods can lack in various conditions it can be some costly and may lead to the result with low accuracy and may lack in predicting the behaviour of drug in the body. AI available now cannot totally replace the traditional methods but can predict the results based on the data available.

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Enhancing thyroid disorder diagnosis with machine learning: Overcoming challenges for accurate detection

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ABSTRACT: The machinery learning for the detection of thyroid disorders is conducted by inputs of medical data from the doctors into algorithms that include hormone levels, imaging results, and symptoms. The machines learn these features to detect the disorders accurately. In order to approach these problems, ensemble learning techniques like a Random Forest and a Decision Tree, as well as methods of data augmentation are represented to get a more trustful result and a better accuracy. This approach which is deploying to overcome obstacles in to data quality and increasing diagnostic precision ultimately will make the systems more relevant and result in great efficiency increase compared to what is there currently. Consequently, it ensures the sustainable clinical utility of thyroid disorder detection algorithm by machine learning approach.

Keywords: Thyroid disorder, ML techniques, Achievement of diagnosis, Problems behind ML approach, High rate of precision, Reliability feature, Data quality, Ensemble learning

1 INTRODUCTION

Identification of thyroid disorders is crucially needed since this will allow preservation of the integrity of the disease and the possible cure or treatment after detection. Machine learning, deemed to be a novel strand, offers a vivacious approach to perfecting the diagnostic process just like it clearly interprets many health details including hormones levels, imaging results, and symptom of disease [2–4,6]. The proposed model takes advantage of the advancing powers of machine learning in respect to accuracy, precision, and computational complexity which in turn aids in the diagnosis of thyroid disorders with high reliability and speed [2–4,6,8,9].

2 RESEARCH METHODOLOGY

The objective is to exploit the ML techniques to develop a better method of thyroid problems classification which is in turn essential for timely intervention when medical care is needed [11–15]. In this system, the problems caused by the randomness of such techniques as Random Forest and Decision Tree are overcome by the ensemble learning method.

3 LITERATURE REVIEW

Review of existing studies – Thyroid disorders pose significant health concerns worldwide, demanding precise and prompt diagnosis to ensure effective treatment and care [4,6–9].

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Focus on data quality – Issues such as noise, incomplete data, and biases within medical datasets present formidable [12,14,15].

4 EXISTING SYSTEM

The critical significance of thyroid dis oorplay diagnostics in healthcare is highlighted in the present day world due to timely and accurate identification of the condition [11–15]. It has the ability to make use of ML techniques to improve this situation by analyzing patient data cells such as hormone levels, image findings, and symptoms and rapidly pinpoint the problem area [14,15]. Two possible drawbacks or challenges for the system include:Two possible drawbacks or challenges for the system include:

- Constraints in Reliability and Applicability
- Challenges with Data Quality

5 PROPOSED SYSTEM

The proposed system aspires to improve the flaws of the present system by employing the especially up-to-date classification strategies inside artificial intelligence [4,8,10]. Consequently, the aforementioned system intends to carry out advanced classification algorithms to make the system more powerful and more applicable to the diagnosis of numerous thyroid disorders [4,5,8,9]. The proposed system offers two key benefits:The proposed system offers two key benefits:

- Enhanced Reliability and Applicability
- Improved Management of Data Quality

5.1 *Proposed architecture*

Machine learning based technique for diagnosing thyroid disorder will involve combining complex classifiers and data augmentation system in order to effectively overcome the existing difficulties [11,12]. Proposed architecture of diagnosing thyroid is shown in Figure 1.

- The use of sophisticated classification approaches.
- Utilization of Data Augmentation Techniques, this approach offered a practical solution to the problem of the limited availability of data in the field of machine learning.

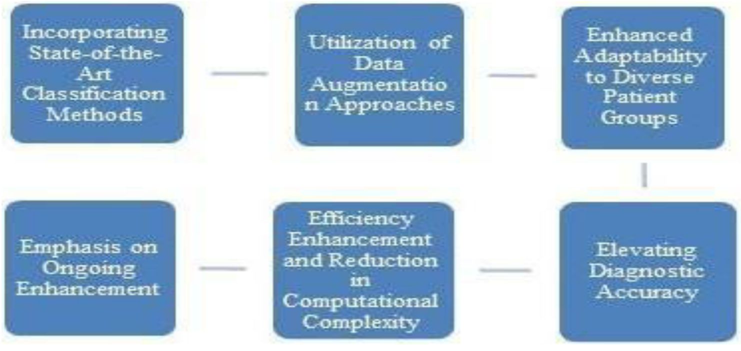
Incorporating State-of-the-Art Classification Methods
Utilization of Data Augmentatio n Approaches
Enhanced Adaptability to Diverse Patient Groups
Emphasis on Ongoing Enhancement
Efficiency Enhancement and Reduction in Computational Complexity
Elevating Diagnostic Accuracy

Figure 1. Proposed architecture of diagnosing thyroid as one possible manner.

Elevated Adaptiveness to Patient Groups with Various Requirements and Characteristics.
- Elevating Diagnostic Accuracy.
- Efficiency Improvement and Scheme for Decreasing the Computational Complexity.
- Enhancement continuation becomes the focal point.

5.2 *Proposed algorithm*

Step 1. Data Collection and Preprocessing: A type of leading biomedical attributes such as hormone levels, imaging resultsand patients' symptoms and preprocess them.
Step 2. Feature Selection: Decide on figures that have been extracted from the preprocessed data after filtering them so that they will summarize thyroid conditions.
Step 3. Decision Tree Construction (ID3): Place ID3 algorithm at the core of the decision tree where the chosen features are the pillars.
Step 4. Tree Pruning: Scale down the level of the decision tree to prevent overfitting and enhance generalization by cutting off the nodes which are not noticeable contributing to accuracy of categorize.
Step 5. Model Evaluation: Carry out measurement of the efficiency of decision tree model with the help of metrics like accuracy, precision, recall, F1- score. The measurements should be done on a validation dataset.
Step 6. Model Deployment: Put the properly trained decision tree model in clinical practice environments which will have to be verified and modified for adaptability.

5.3 *Input dataset*

The kind of data (Table 1) is patient's demographic and medical details, involving age, gender, and of course everything related to thyroid function, whether it's the use of thyroxine medicine or the record of thyroid surgery or pregnancy or illness [11,13,14]. Besides it is comprised parameters that include level of thyroid-stimulating hormone (TSH), triiodothyronine (T3), and thyroid (T4).

Table 1. Thyroidism information.

1	Age	Continuous
2	Gender	M,F
3	Hyper Thyroid	F,T
4	Hypo Thyroid	F,T
5	Pregnant	F,T
6	T3 value	Continuous
7	T4 value	Continuous
8	TSH value	Continuous

6 EXPERIMENTAL RESULTS

The experimental outcomes (Figure 2) derived from the dataset titled "Enhancing Thyroid Disorder Diagnosis with Machine Learning: The articles "Advances in the Thyroid Disorders and Their Detection" [2,3] and "The Current Position and Future of Thyroid Disease Detection" [5–7] describe encouraging gains in the precision, accuracy, and computational efficiency of thyroid disorder diagnosis by using the Decision Tree (ID3) and Random Forest algorithms. This research obtained an outstanding 95% accuracy and 75% precision, and still spendable CPU at the cost of O(g). 06 seconds [2,3,5–7].

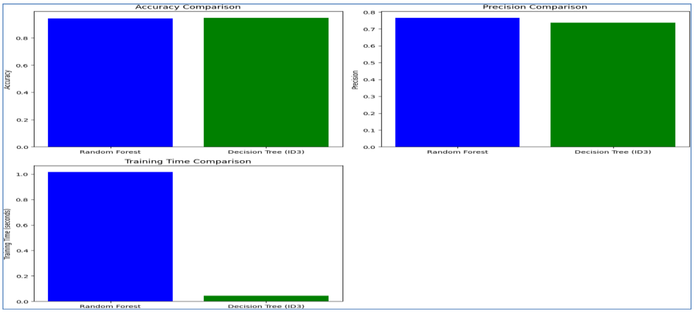

Figure 2. Accuracy, precision, training time, comparison graphs.

7 DISCUSSION OF RESULTS AND RECOMMENDATIONS

Assume that an accuracy rate of 95% and a precision rate of 75% [2,4,6,8] will be achieved. A comparison between the old and generated systems describes bigger enhancements in accuracy, precision and a reduced complexity in the computational process, mostly because of the application of an ensemble learning and data augmentation approach [2,4,6,8].

7.1 *Performance evaluation*

Our study can attain a high accuracy rate at 95%, with the precision rate of 75%, and containing a minimally long computation time with the time complexity at 0. 06 seconds [2–6].

7.2 *Accuracy*

Achieving an impressive accuracy of 95% level.

$$Accuracy = \frac{TP + TN}{TP + TN + FP + FN} \tag{1}$$

7.3 *Precision*

Achieving a significant precision rate of 75%.

$$Precision = \frac{TP}{TP + FFP} \tag{2}$$

Our conclusions regarding the use of the machine learning based diagnostic system for thyroid disorder detection accuracy, precision and work efficiency as well.

7.4 *Sensitivity*

Improvements in accuracy, precision, and computational efficiency.

$$Sensitivity = \frac{TP}{TP + FN} \tag{3}$$

7.5 *Specificity*

Improvements in accuracy, precision, and computational efficiency.

$$Specificity = \frac{TP}{TN + FP} \tag{4}$$

7.6 *F1 score*

Progress was noted in accuracy, precision, and computational efficiency.

$$F1Score = \frac{2 * Precision * Recall}{Precision + Recall} \tag{5}$$

7.7 *Area under the curve*

During our assessment of the machine learning-based diagnostic framework for identifying thyroid disorders.

$$AUC = \frac{\sum ri(Xp) - Xp(Xp + 1)/2}{Xp + Xn} \tag{6}$$

8 CONCLUSION

In short, our evaluation of the diagnostic framework based on machine learning for identifying disorders of the thyroid suggests that this technology has achieved notable progress in exactitude, accuracy, and computational speed, and these advancements seem to underline the capability of integrating ensemble learning techniques and data augmentation methods to improve the diagnostic efficacy. The next phase of this work includes various dimensions such as progress in ensemble learning approaches and data augmentation techniques to enhance the diagnostic accuracy and applicability over the wide spectrum of the patients and healthcare establishments with the general aims of improving the patients' outcomes and the standard of the healthcare delivery system in the diagnosis of the thyroid disorders.

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Natural remedies for management of primary dysmenorrhea in adolescent girls

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ABSTRACT: Adolescence, considered to be a prime period in life of an individual is the age group when the body undergoes numerous physiological and physical changes. It is in adolescence only when males and females enter puberty. Males as well as females both exhibit signs of secondary sex characteristics. Achieving menarche has a significant importance in a female's life but it brings a lot of very painful experience for many. Menstruation is not only just bleeding but it causes a lot of discomfort which can be agonizing for many females and they require some kind of pain relievers to alleviate pain. Most of the time pain experienced by young adolescent girls also called primary dysmenorrhea is ignored and underdiagnosed. Use of natural remedies can be fruitful to improve the quality of life of young adolescents.

Keywords: Adolescent, Menstruation, Primary dysmenorrhea, Natural remedies

1 INTRODUCTION

Dysmenorrhea is the most common problem observed in adolescents and young women. It not only affects their working but also has an impact in their quality of life [1]. Dysmenorrhea causes incapacitating pain and a woman is not able to do even activities of daily routine which one does on regular basis. Women experiencing dysmenorrhea tend to take more of medical leaves on emergency grounds affecting their attendance or profile, avoid gatherings and functions and not able to concentrate on work at hand or studies.

Adolescence phase comes in the life of every individual and is a phase of transition from childhood to adulthood. Child's body goes through physical, emotional as well as hormonal changes and girls during puberty undergoes major physiological change in their body leading to 'menstruation' often accompanied with dysmenorrhea [2]. It is experience of cramps and pelvic pain during menstruation in women of reproductive age. It is most common problem/condition almost all adolescent girls and young age women experience, but it usually goes undiagnosed, as they do not prefer to seek medical help [3]. In many cultures women is considered to be impure when she is having menstruation and is asked to maintain distance with others and not even enter the kitchen. This mindset leaves a woman in a dilemma of bearing the pain or seeking help. Most of the time it has been observed that women or young adolescent girls tend to skip schools, colleges and office as the pain is so excruciating that it often leaves them with no option instead of taking rest. Some even tend to choose taking over the counter medications with no idea of its side effects on longer run. Instead of choosing over the counter medications there are various other alternative forms of remedies that can be used after

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diagnosis that whether dysmenorrhea is due to secondary causes or not. The use of natural remedies will not only reduce the pain during dysmenorrhea but also improve quality of life.

2 LITERATURE REVIEW

The prevalence of dysmenorrhea ranges from ranges from 16.8% to 81% and highest recorded rate is 91% [4]. As per Ethiopian standard guidelines dysmenorrhea occurs in about 50% of menstruating women and about 10–15% of females experience pain to such an extent that they need to take break from daily activities. Though it might not be life threatening condition but it usually affects the quality of life of females leading them inefficient and disable. It also affects their mental capacity leading to decreased participation in daily chores [5]. It not only limits child's social, academic and sports activities but also leads to skipping of school leading to absenteeism [6]. Research report submitted by Osunuga A showed that percentage of girls and women who seek medical care during dysmenorrhea ranges only from 9–16%. It was also found that few girls use hormonal supplements to manage pain during menstruation [7]. As per its pathology dysmenorrhea can be categorized into primary and secondary. Though difference exists in presentation of dysmenorrhea in person to person but there is difference in perception and management between various groups of females in urban and rural area. Ease in access to pharmacy and internet services has increased the use of pharmacological methods to manage dysmenorrhea by women and girls living in urban area [8].

Though both pharmacological and non-pharmacological methods can be used to manage pain during menstruation but pharmacological methods can lead to addiction or can negative impact on cognitive function in later course of time [9]. Thus, non-pharmacological methods should be emphasized more as there is little or no effects [10]. There is very less evidence on use of natural remedies in dysmenorrhea, hence present study was undertaken to find the evidence and efficacy of natural remedies that can be used in managing pain during menstruation with no side effects.

3 METHODOLOGY

The literature related to dysmenorrhea, primary dysmenorrhea and its symptoms and natural remedies for management was obtained from google search engine, google scholar, pub med, IEEE and published research reports and articles. The objective of the review was to identify the natural remedies for management of primary dysmenorrhea. The words used were dysmenorrhea, primary dysmenorrhea, secondary dysmenorrhea, alternative therapies and natural remedies. The literature published from 2015 till present were included for review. The process of review in shown in Figure 1. The review is presented under following heading: primary dysmenorrhea, physiology and presenting symptoms and natural remedies for management.

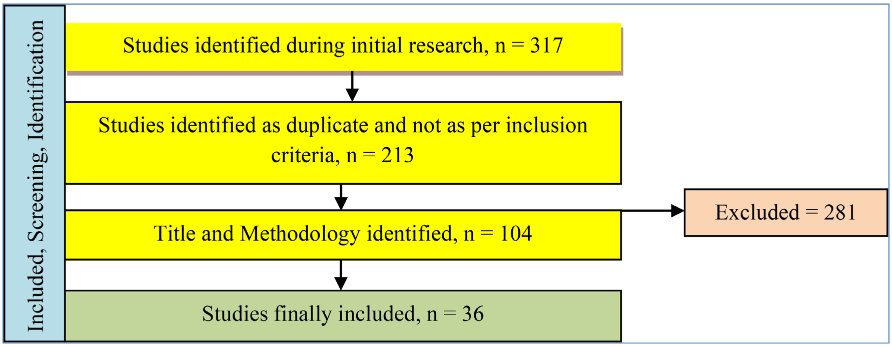
Included, Screening, Identification
Studies identified during initial research, n = 317
Studies identified as duplicate and not as per inclusion criteria, n = 213
Title and Methodology identified, n = 104
Excluded = 281
Studies finally included, n = 36

Figure 1. Flow diagram for selection process.

4 DISCUSSION

4.1 *What is primary dysmenorrhea?*

Primary Dysmenorrhea is spasmodic and pain cramps that occurs in lower abdominal wall. It begins before the onset of menstruation without underlying cause or pelvic pathology. Usually, its onset begins during adolescent phase within 6–24 months after menarche as highlighted by Lacroix, 2024. It has a cyclical pattern and lasts up to 72 hours [11]. As a result, young girls feel embarrassed and also considers it as taboo, and tend to tolerate the pain and an unavoidable response to menstruation. Whereas, secondary dysmenorrhea occurs due to pathological problems like endometriosis, chronic inflammatory pelvic diseases, adenomyosis, ovarian cysts, congenital anomalies and complication due to contraceptive devices [6,12]. Here, the pain is subtle or constant and is identified in females older than 24 years with no history of dysmenorrhea [13].

4.2 *Physiology and presenting symptoms*

As the endometrium sheds during the menstruation, it leads to release of prostaglandins accompanied by blood leading to breakdown of cell membrane. It leads to constriction of blood vessels in endometrium and also rouses myometrial contraction further leading to tissue ischemia, endometrial disintegration, bleeding and pain [14]. Also, upregulated cyclooxygenase enzyme (COX) activity leads to pain during primary dysmenorrhea. Girls may experience sharp, intermittent spasms usually supra-pubic pain which may radiate to lower back and inner aspect of thigh and is at its peak on day one or two. The severity may extend from 24–36 hours. Other symptoms which girls experience includes nausea, vomiting, diarrhea, fatigue, fever, light-headedness accompanied with vasomotor symptoms like cold sweats, pallor and fainting [15].

4.3 *Natural remedies for management*

Usually, adolescent girls with primary dysmenorrhea do not seek medical aid from health professionals and choose to take over the counter drugs like analgesics and other alternative therapies. Also, self-medications used by them to treat dysmenorrhea are not effective. Therefore, adolescent and young girls should be counselled or made aware about natural remedies for management of dysmenorrhea. Some of the remedies include:

4.3.1 *Heat therapy*

Various systematic reviews suggest use of heat patch of 39°C temperature for 12 hours a day and was also found to be effective as ibuprofen taken 400mg three times a day. Even heat wrap was found to be effective [16,17].

4.3.2 *Fenugreek*

During primary dysmenorrhea fenugreek seeds has been found to be therapeutic against infertility and fungal infections. It was also found to be good analgesic and antipyretic. In a study conducted in 2014, reported that the use of fenugreek seed capsule (900mg) during menstruation three times day for first three days helps to reduce primary dysmenorrhea [18,19].

4.3.3 *Ginger*

It has been traditionally used to treat many ailments. In order to reduce or alleviate pain during dysmenorrhea, ginger can be boiled in water, strained and then consumed thrice a day to relive primary dysmenorrhea [20]. Further, consumption of ginger powder capsule 500 mg thrice a day for three days help to reduce primary dysmenorrhea [21,22].

4.3.4 *Aromatherapy*

Herbs like lavender oil, clary sage oil, peppermint oil, cypress oil has also been found to be effective in reduction primary dysmenorrhea by reducing prostaglandin levels thereby improving circulation. It also helps to reduce cramps due to presence of fragrance. These oils can be massaged in the lower abdominal area for 5–10 minutes duration, not only helps to reduce cramps but also cure uterine problems and reduce stress [23–25].

4.3.5 *Exercise*

Some exercises like Zumba [26], yoga [27,28], Kegel, aerobics (walking and jogging) [29,30] and stretching exercises have been found to be effective in pain reduction by increasing anti-inflammatory cytokines which will also help to reduce menstrual flow and prostaglandins released [31,32].

4 CONCLUSION

Due to cultural and ethnic constraints many adolescent girls suffering from primary dysmenorrhea go underdiagnosed or may be treated inadequately. This not only affects their quality of life but also affects their mental health and leads to skipping of schools. Hence, instead of relying only on drugs at an early age it is better to use herbal remedies to manage primary dysmenorrhea which not only will alleviate pain but will also treat other uterine related problems.

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Construction of big data platform for Indian herbal medicine based on data acquisition

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ABSTRACT: In the current scenario, the herbal drug requirement is increasing significantly, experiencing an increased demand to improve healthcare. By harnessing the power of big data, companies in the herbal market can gain a competitive edge and drive sustainable growth in the industry [1]. A big data platform plays a crucial role in the Indian herbal market by enabling data-driven decision-making, optimizing supply chain operations, ensuring product quality and safety, gaining market intelligence, and facilitating regulatory compliance [2]. Conventional pharmaceutical practices, while recognized by precise therapeutic frameworks like Ayurveda in India, are not yet widely acknowledged by local individuals. This paper proposes leveraging IoT (Internet of Things) technology in the information procurement mode to address these challenges. By utilizing IoT innovation, specifically the "Web of Things," and employing both the follow mode and social mode of the conventional pharmaceutical industry chain, the paper aims to secure easy availability of quality raw herbals to the industry and connect stakeholders through vast amounts of information.

Keywords: Indian Herbal Medicine, Data platform, IoT

1 INTRODUCTION

In the last few decades, Indian traditional medication systems have captured interest worldwide. A large number of medicines, even in other systems of medication, are derived from herbal plants that have long been utilized by the Ayurvedic system of medication. Due to their high potential and low toxicity, the herbal medicine market is expanding. However, currently, there are several issues in establishing a balance between market demand and material availability. Until today, most of the traditional Indian herbal information has been encapsulated in works such as Indian Materia Medica and Ayurveda Materia Medica [3]. IMPPAT is the largest repository of phytochemicals from Indian medicinal plants to date, which marks the joint efforts of ongoing digitization of our traditional information as a wealth for future generations. We believe that our proposed model can effectively contribute to advancing the theoretical understanding of the Indian herbal medication system and for future research involving empirical testing. We did a thorough review of the existing literature to identify gaps in the proposed model. We combined deductive reasoning, conceptual analysis, and expert consultation to propose our model and refine its structure and components. We also gave attention to the selection of variables and measures that are included in the model, while ensuring that they are aligned with the framework and adequately capture the phenomena of interest i.e. to propose a big data platform for the Indian herbal medication system.

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2 LITERATURE REVIEW

2.1 *Indian herbal medication system: An overview*

India is being considered as birth place of Ayurveda, which is one of the oldest ways of curing diseases which not only includes medication but also incorporates yoga, meditation, etc. It accentuates creating a balance between personal, spiritual, and intellectual well-being. The knowledge of herbal medication is mentioned in ancient literature of India such as Charaka Samhita and Sushruta samhita which includes preparation of herbal preparations their cultivation, standardization, etc. Herbal medication is also used and transferred by local people from generation to generation as a part of the tradition [4,5]. In 2016, Patel, W *et al.*, studied utilization of IoT and wireless sensors to enhance healthcare by accessing GSM system and cell phones [6]. In 2017, Kapoor, L. D; prepared a handbook with approx 250 plants for easy and appropriate identification of herbs [7]. In 2020, Latif G designed a Wireless Sensor Network and Cloud based system with IoT prototype for monitoring patient health using real time management [8]. In 2022, Roopashree, S. *et al.*, used machine learning approach for preparing an authentication system to identify therapeutic herb used in Indian traditional medication system [9].

In 2023, Sharma, S. discuss various, machine learning models to understand herbal drugs for easy recognition and betterquality evaluation [10].

2.2 *Integration with modern medicine*

While the Indian herbal medication system is rooted in traditional practices, it coexists with modern medicine in India. Many people choose to integrate herbal remedies with conventional treatments to complement their healthcare regimen. Additionally, validation of the safety and efficacy of traditional medicines is also becoming an area of growing research nowadays [11].

2.3 *Stages of herbal drug medication*

The cultivation to marketing process in the Indian herbal industry involves several stages, each essential for producing high-quality herbal products and bringing them to market. Here are the typical stages involved:

2.3.1 *Cultivation of medicinal plants*

The need for pertinent information among agriculturists comes about in the development of less genuine herbs. Additionally, deficient data on Indian herbs results in less utilization of accessible restorative plants as well as less plant observing is drained. Maintainable collection, development, and preservation of plant riches are hence vital so that they can be utilized as the conventional source for the future too [12]. Selection of suitable land for cultivation, considering factors such as soil quality, climate, and water availability. In some cases, acceptable component levels cannot be kept up in case required at any particular region to the required quality whereas in some large amounts of pesticides and heavy metals may also cause the reason of substandard quality of herbal medicinal plants.

2.3.2 *Standardization & preliminary evaluation*

Different techniques such as extraction, formulation, and product development can lead to value addition of herbal products harmlessness and enhance the effectiveness and marketability of herbal products. Implementation of quality control measures to ensure the purity, potency, and safety of herbal products. Presently after the collection of therapeutic herbal it's a tough assessment to recognize the finest quality among them because of the need for more or less quantitative specialized attributes. It may happen that a specific plant part is showing the pharmacological effect however toxic effects were being given by others due to variations in active ingredients. It can be characterized by using a proper database [13].

2.3.3 *Manufacturing, distribution, and supply chain management*

Establishment of distribution networks to reach target markets efficiently. Logistics management to ensure timely delivery of products while maintaining product integrity. Collaboration with wholesalers, retailers, and online platforms for product distribution. By building proper demand and supply data traceability system can be prepared by to satisfy the demand for quality herbal products. As per the regulatory guideline D & C Act Schedule T compliance has been compulsory since 2006 for the herbal industry but still only a few Indian Herbal industries are GMP compliant [14].

3 OBJECTIVES OF THE STUDY

Improving the potential loopholes that restrict the construction of an updated and validated big data platform requires ongoing monitoring, maintenance, and improvement of the database infrastructure. Regular updates, data validation processes, user feedback mechanisms, and robust security protocols can help mitigate these challenges and enhance the overall utility and reliability.

3.1 *Building a data platform based on the collected data*

Information stage planning for herbal plants is based on information collection beginning from arranging to develop, cultivate, preliminary evaluation to sales and distribution. The total handle situating and checking utilizing genuine-time notices is required so that common understanding can be built up between growers and government, protection ventures, and budgetary administrations so that comprehensively authentic quality of herbal drugs can be accomplished and all can be profited [15]. This integrated system between different classes of beneficiaries can be depicted in Figure 1.

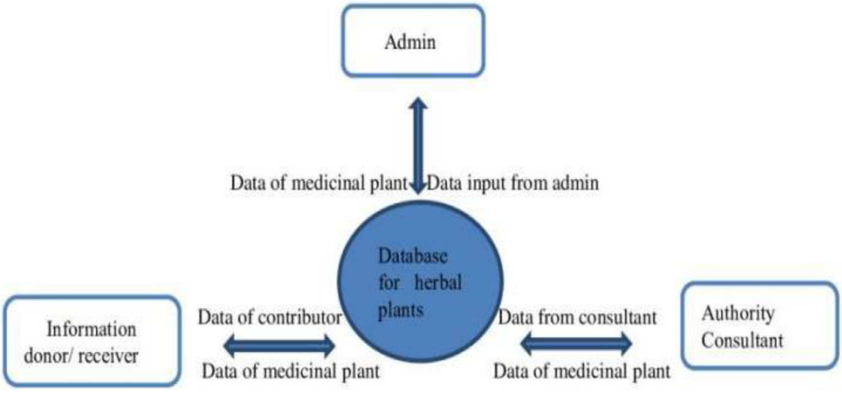

Figure 1. Diagram of proposed system: Source: [15].

3.2 *Data platform designing*

The concept of Big Data was first elaborated in an article from the Association for Computing Machinery (ACM) digital library in October 1997. It has been introduced to enumerate the challenge of distortion and clutter in the available systems of huge amounts of datasets in computer science. However, after then, it has become quite popular among academia and researchers. [16,17]. So, by creating a big data platform there can be utilization of real-time warnings, requirements for growers, process traceability, data analysis, and incorporation of new technologies. This whole system can provide a link between the herbal industry and agriculturalists as well as government organizations which will ultimately lead to the economic growth of local individuals as well as of the country as shown in Figure 2.

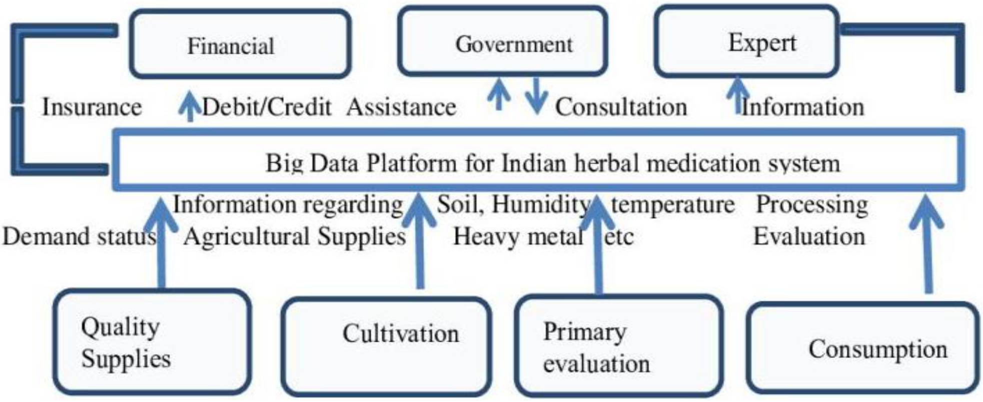

Figure 2. Big data platform design: Source [18].

3.3 *Data acquisition*

Data acquisition can be done by using various types of digital technology such as implementing various aerial sensors, smart mobiles, bar code, or any other type of coding system by using a Web of Things [19]. There is a tremendous increase in collected data due to the increased use of digital technology which is required to be managed, stored, and interpreted appropriately for future research prospects. Various modes can be used for data collection and interpretation [20].

3.3.1 *Social mode*

In this new era there is a requirement to step up and enforce IOT (Internet of Things) based strategies such as the use of satellite drones for collecting information regarding soil, area and yield improve the quality and quantity of medicinal plants. The number of internet users is predicted to reach 900 million by 2025, this can be a great opportunity to integrate the government and growers create awareness among growers and connect them to herbal industrialists and benefit by direct money transfer digitally [21]. The rate of internet penetration in India is elevated to nearly 48.7 percent in 2022, which was just about four percent in 2007 as shown in Figure 3 [22].

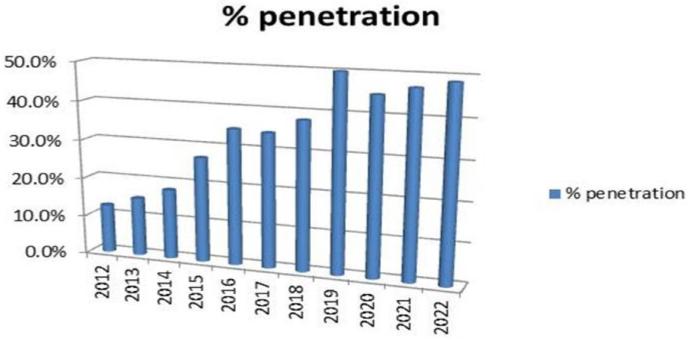

Figure 3. Percentage penetration of Internet in India: Source: [22].

3.3.2 *Traceability mode*

In a market survey, published in Linked-in on 9 February, 2024 as Ayurvedic Market size, share and Growth Report, 2031 reported that the global Ayurvedic Market size was valued at USD 5304.25 million in 2024 and is expected to expand at a CAGR of 11.89% during the forecast period, reaching USD 10408.51 million by 2031. Various modes that are used to supervise cultivation, collection sale, and manufacturing of herbal medicament can be channelized by using different traceability systems based on IOT which will cause a significant improvement in building an integration between different beneficiaries such as growers, government, financial institutions researchers. It will also help to maintain indistinguishably the quality parameters that are linked to the steadiness of photochemical layouts and will also result in obtaining herbals with standardized quality attributes so that the whole process can be made transparent and reliable [23,24]. The correlation between various aspects can be seen in Figure 4.

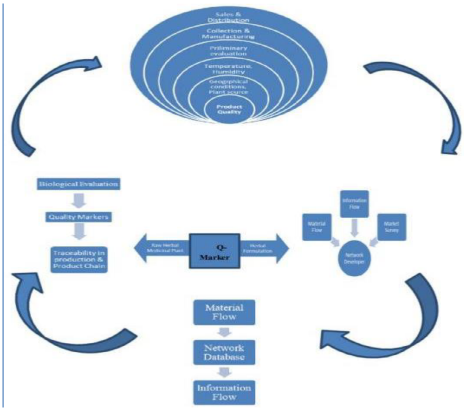

Figure 4. Traceability system of herbal medicine Source: [25].

3 CONCLUSION

The Indian herbal industry comes with a set of advantages and disadvantages due to the lack of data management. It is difficult to ensure the quality of traditionally used plant materials, which hinders the development of the Indian herbal industry on a global scale. This study suggests fully utilizing the web of things technology to gather information from farmers, identify key quality criteria, and understand market demand from pharmaceutical companies. This can be achieved through traceability and social modes, ultimately constructing a large-scale data platform for Indian traditional plants and medicines. The Indian herbal industry significantly impacts global markets, necessitating the alignment of herbal medicines with international standards. This alignment would benefit local governments and financial institutions alike [26].

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Nursing in the digital age: A study of transformative impact of AI on healthcare practices

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ABSTRACT: Studying and assessing the changing application of artificial intelligence (AI) in nursing practices is the goal of this survey article. AI technology integration in healthcare settings, especially nursing, offers the potential to improve efficiency, improve patient care, and improve health outcomes. The use of AI in nursing schools helps nurses become more skilled practitioners. In order to gather data for this study, a survey about the use of AI in several nursing fields was undertaken. The survey results concluded that there is a scope of AI in nursing practices and it is also required to introduce AI techniques in educational practices. The survey includes 100 audience for the questionnaire that includes the knowledge, practical exposure and the shortcomings in the utilization of Artificial Intelligence in different sectors of nursing. The outcomes of all questions are displayed in pie-chart form. This article also discusses current applications of AI in nursing, and identifies future prospects for the implementation of AI technologies.

Keywords: Artificial Intelligence, Healthcare, Nursing Practices, Education

1 INTRODUCTION

The increasing importance of AI in healthcare and the nursing profession is in demand nowadays. As technology continues to advance, the potential involvement of AI in nursing practices has become increasingly pivotal. In the ever-evolving landscape of healthcare, AI is revolutionizing nursing practices by enhancing efficiency and precision. The incorporation of AI into nursing practices is reshaping the way healthcare professionals deliver patient care. Artificial Intelligence is ushering in a new era in nursing, offering innovative solutions to challenges in diagnostics, treatment, and patient interaction. AI has the ability to improve patient outcomes, accuracy, efficiency, and a host of other elements of nursing procedures. Several instruments and technologies related to AI are being integrated into nursing

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practices like Electronic Health Records, Clinical Decision Support Systems, Telehealth and Remote Patient Monitoring, Natural Language Processing, Robotics in Healthcare, Predictive Analytics, Chatbots and Virtual Health Assistants, Wearable Devices, Simulation and Training Tools, Medication Management Systems. Nursing practices are undergoing a transformative journey with the infusion of AI, promising improved patient outcomes and streamlined workflows [1–3,18]. In the contemporary healthcare setting, AI stands as a formidable ally, augmenting the capabilities of nursing professionals and elevating the quality of care. As nurses navigate a technology-infused healthcare environment, the role of AI emerges as a catalyst for innovation and optimization [4,16]. AI's impact on nursing practices is characterized by its ability to handle complex tasks, optimize workflows, and deliver data-driven insights for better clinical decisions. Nursing, enriched by the capabilities of AI, is experiencing a transformative journey that holds the promise of improved patient outcomes and a more resilient healthcare system [5,17].

2 LITERATURE REVIEW

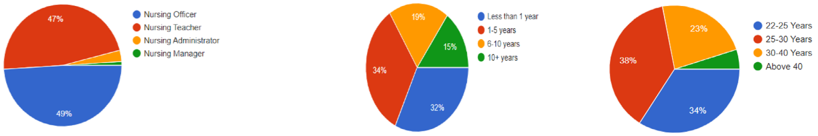
The incorporation of AI in nursing practices has garnered significant attention as technology continues to reshape the healthcare landscape. This study of the literature aims to provide an in-depth understanding of the state of AI in nursing today, examining its effects on workflow optimisation, patient care, and the potential and difficulties it presents. One of the primary applications of AI in nursing is in diagnostics and decision-making processes. Studies done by researchers to highlight that AI algorithms can analyse vast datasets to assist nurses in more accurate and timely diagnoses, leading to improved patient outcomes [6,7]. AI's role in patient monitoring and predictive analytics is crucial for proactive healthcare management [8,9,51]. AI tools streamline administrative tasks, allowing nursing professionals to provide efficient time to direct patient care and fostering an effective healthcare delivery system. The potential benefits of AI in nursing are substantial, ethical considerations and challenges must be addressed. Efficiency gains through workflow optimization is discussed [10]. The issues related to data security, patient privacy, and the responsible use of AI technologies in healthcare is emphasized [11]. The necessity of providing adequate training and education for nursing professionals on AI technologies is emphasized [12]. The research on the exploration of the dynamics of human-AI interaction in nursing, emphasizing the complementary nature of AI and the preservation of human empathy in patient care is discussed [13]. The literature reviewed demonstrates the multifaceted impact of AI on nursing practices. It can improve diagnosis accuracy, streamline operations, and handle ethical issues. However, ongoing research, education, and ethical frameworks are essential to harness its benefits responsibly and ensure that patient-centred care remains at the forefront of healthcare delivery [14,15].

3 METHODOLOGY

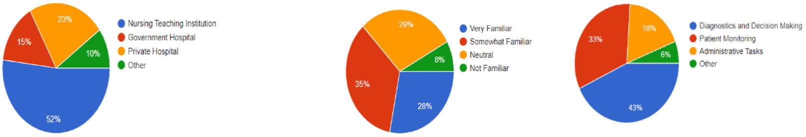
The researchers selected different professions of nursing sector as audience for this study. The study is based on multiple choice questionnaire. It focuses on the use of AI in Nursing education and practices. The sample size of this survey is 100. A google form was circulated between different nursing professionals. The google form comprises multiple choice questions to take the knowledge of audience in the field of AI related to nursing practices.

4 RESULTS AND DISCUSSION

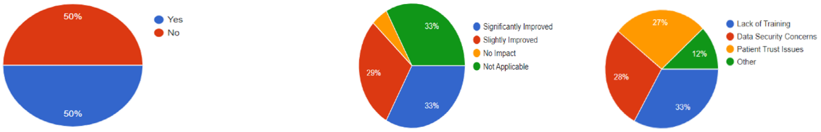
The survey includes the registered nurses, nurse practitioners and nurse manager/administrator. Figure 1(a) represents the 49% nursing officer, 47% nursing teacher, 3% nursing



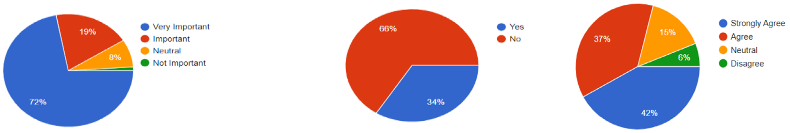
(a) Different nursing professions (b) Job Experience (c) Age Group of professionals



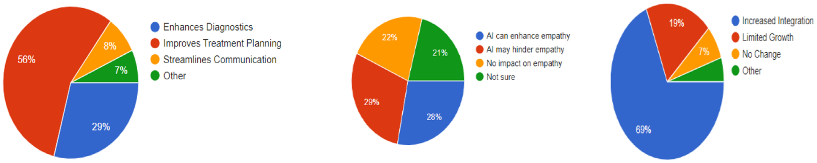
(d) Type of Facility (e) Familiarity with AI in healthcare (f) Most benefitted aspects of nursing practice using AI



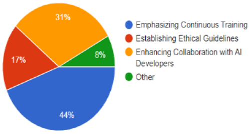
(g) Implementation of AI in healthcare facility/educational institute (h) Impact of AI on efficiency and accuracy (i) Challenges of AI integration in nursing practices



(j) Importance of data security and patient privacy (k) Trained on AI tools related to nursing practices (l) Importance of AI education for nursing professional



(m) Contribution of AI to improve patient care and outcomes (n) Effect of AI on Empathy (o) AI integration impact on nursing practices in future



(p) Adaption of AI in nursing

Figure 1. (a)-(p) Response analysis of survey questionnaire.

administrator and 1% nursing manager of different professions. Figure 1(b) represents the experience of candidates. 32% have experience less than 1 year, 34% 1-5 years, 19% 6-10 years, 15% 10+ years. Figure 1(c) represents the age group 34% candidates are in age group of 22-25 years, 38% are in 25-30 years, 23% candidates are from 30-40 years and 5% are above 40 years. In the category of type of facility as shown in Figure 1(d) 52% are in nursing teaching institution, 15% are in the category of government hospital, 23% are in private hospital, 10% are in other category. In case of familiarity with AI in healthcare as shown in Figure 1(e) 28% are very familiar, 35% are somewhat familiar, 29% are neutral and 8% are not familiar. As the question asked ‘which aspects of nursing practice do you believe can benefit most from the integration of AI?’43% of candidates think diagnostics and decision making, 33% patient monitoring, 18% administrative tasks and 6% other are the most benefited aspect of integration of AI in nursing practices as shown in Figure 1(f). Figure 1(g) represents that 50% of candidates says yes and 50% says no that there is implementation of AI technology in their healthcare facility currently.

33% of candidates accepted that AI significantly improved their efficiency and accuracy in nursing tasks, 29% says slightly improved, 5% says no impact and 33% replies not applicable as shown in Figure 1(h). 33% of candidates say lack of training, 28% says data security concerns, 27% says patient trust issues and 12% says other are the challenges perceived by them in the integration of AI into nursing practices as shown in Figure 1(i). 72% of people say data security and patient privacy concerns is very important, 19% says important, 8% candidates are neutral and 1% says not important during the utilization of AI as shown in Figure 1(j). 34% says that they have received specific training on using AI tools in their nursing practices and 66% says no as shown in Figure 1(k). 42% of candidates are strongly agree, 37% are agree, 15% are neutral and 6% are disagree on the importance of AI technology education for nursing professionals as shown in Figure 1(l). AI contribution for the improvement of patient care and outcomes, 29% suggests enhances diagnostics, 56% suggests improves treatment planning, 8% says streamlines communication and 7% are in another category as shown in Figure 1(m). 28% says AI can enhance empathy, 29% says AI may hinder empathy, 22% says no impact on empathy, 21% are not sure as shown in Figure 1(n). In next 5-10 years, 69% of candidates says AI will increase integration, 19% of candidates says limited growth, 7% says no change, 5% are in other category as shown in Figure 1(o). 44% of candidates believes that the nursing profession adapt to and embrace the evolving role of AI while maintaining a patient-centred approach emphasizing continuous training, 17% says establishing ethical guidelines, 31% enhancing collaboration with AI developers, 8% other as shown in Figure 1(p).

5 CONCLUSION

The scope of AI in nursing practices is expansive and transformative, offering unprecedented opportunities to elevate the quality of patient care. The incorporation of AI can revolutionize nursing workflows, enhancing efficiency, and nurses-patient interactions. As technology evolves, the future scope of AI in nursing includes advanced diagnostics and predictive analytics, ultimately leading to improved patient outcomes. AI-driven technologies are poised to automate routine tasks, freeing up valuable time for nursing professionals to engage in critical decision-making and holistic patient care. The collaborative synergy between nurses and AI systems is essential for maximizing the benefits of technology while preserving the human touch and empathy inherent in nursing practices. The future scope also involves addressing ethical considerations, ensuring the responsible use of AI to safeguard patient privacy and maintain the trust of individuals under nursing care. Ongoing research and development will further refine AI tools, making them more intuitive, adaptable, and seamlessly integrated into the dynamic healthcare environment. The scope extends beyond clinical settings, influencing nursing education with AI-powered learning tools that prepare future healthcare professionals for the evolving landscape. A complete knowledge of the scope of AI in nursing necessitates a multidisciplinary approach, involving collaboration between healthcare professionals, technology experts, and policymakers. Embracing the utilization of AI in nursing practices requires a proactive stance, continuous education, and a commitment to fostering a healthcare ecosystem where innovation complements the core principles of compassionate and patient-centred care.

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Brain tumor detection using integrated approach of FCM & convolutional neural network

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ABSTRACT: In modern medical imaging the process of detecting tumors in brain is a very crucial and sensitive task, with the potential to have a significant impact on patient outcomes. This abstract provides an overview of the difficulties, most recent developments, and current research in brain tumor detection is given in this abstract. For the purpose of early diagnosis, medical professionals employ advanced imaging techniques such as MRI images and CT scans. These modalities are essential tools in detecting and evaluating various medical conditions at an early stage, allowing for timely and accurate treatment planning. In the past radiologist were evaluated manually but with advance techniques of deep learning particularly convolutional neural networks (CNNs), the field has experienced a revolution. These AI-based methods have shown encouraging results in automating the identification of brain tumors, increasing accuracy, and lessening the workload for medical personnel when combined with sizable and varied datasets. Yet, there are still issues, such as the requirement for more datasets, the interpretability of AI models, and CNN achieved a really impressive accuracy of 97.87% in our study. The paper's central idea revolves around the use of texture based and statistical criteria for distinguishing the normal and aberrant pixels.

Keywords: Computed Tomography (CT), Brain tumor, CNN, deep learning, Magnetic resonance imaging (MRI), image classification

1 INTRODUCTION

Brain tumors are a dangerous medical condition that sometimes be fatal and affects people of all ages. Modern medical imaging technology, as well as advances in artificial intelligence, have opened the way for novel methods to brain tumor identification. This paper, presents the prominence of premature detection of tumors in brain though images by in incorporating the robust Deep learning techniques like: Convolutional Neural Networks (CNNs), the problems faced by brain tumors, and the possible benefits of using CNNs in the healthcare industry. The FCM method is used to identify iron-rich areas in the brain. These areas are more clearly visible in MRI scans compared to the results obtained using the K-means method. [12]. Brain tumors are abnormal tissue growths that can be either benign or malignant. Depending on their size, location, and kind, these unregulated cell divisions can result in a variety of neurological symptoms. Headaches, seizures, cognitive deficits, and motor dysfunction are possible symptoms. Prompt medical action, such as surgery, radiation therapy, or chemotherapy, is contingent upon early identification. Different methods are used to find tumors in MRI images. In order to detect the tumors in brain with high accuracy and correctness, robust clustering techniques such as color-based and histogram-based techniques are incorporated in the initial stages. [15] Brain tumor detection relies heavily on

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medical imaging methods such as computed tomography(CT) scans and magnetic resonance imaging(MRI) images. Medical experts may more easily visualize and characterize aberrant growths in the brain because to these sophisticated cross-sectional reconstructions of the brain produced by these modern imaging techniques. However, deciphering these intricate pictures is sometimes a labor-intensive task and poses a serious problem. Highly qualified radiologists must possess the specific knowledge and analytical abilities needed for this work. They must carefully examine the pictures to find even the smallest signs of cancer. The expanding volume of medical imaging data, along with the requirement for accurate and rapid diagnosis, has fueled the development of automated systems to assist healthcare workers. CNNs, a subtype of artificial neural networks, have emerged as an effective tool for processing and evaluating medical pictures. These networks are inspired by the human visual system and excel in image identification and pattern recognition tasks. CNNs have demonstrated great performance in a range of medical imaging applications, including tumor identification and classification. Brain MRI images are mainly used to detect tumor and track their growth. This information helps doctors to diagnose and treat tumor. [13] The use of CNNs to detect brain tumours has several significant advantages. CNNs can also help to reduce the risk of human error. In this work we presented an efficient and successful approach based on both conventional classifiers and convolutional neural networks that used to detect brain tumor without the need for human intervention.

2 LITERATURE REVIEW

The most challenging and demanding tasks involve isolating the region of interest from an object, such as separating a tumor from an MRI brain image [1]. Researchers globally are dedicating efforts to this field to identify the most effective methods for segmentation. Now-a-days, segmentation using neural networks produces notable results, and the use of this model is growing daily [2]. Researchers are now suggesting a variety of machine learning strategies to identify brain cancer utilizing the massive quantity of MRI data being collected. This strategy is significant because early detection of brain tumours is essential for successful treatment and a good prognosis for patients. Machine learning algorithms can identify complicated patterns in MRI images that are difficult for human radiologists to notice, resulting in faster and more accurate diagnoses. These approaches include supervised learning, unsupervised learning, and deep learning models, each of which has distinct advantages in processing and interpreting medical imaging data.

2.1 *CNNs in medical imaging*

Medical image analysis has been transformed by CNNs. These neural networks are especially well-suited for processing medical pictures since they are inspired by the human visual system and perform very well in tasks involving pattern identification [3]. CNNs' hierarchical layers enable them to extract complicated information from pictures, which is a crucial capability for the identification of brain tumors.

2.2 *Incorporating DL techniques for identifying and classifying tumors in brain*

In deep learning, brain tumor identification and classification, Convolutional Neural Networks (CNNs) are trained on medical pictures, most often MRI scans. Validation, model training, and data preparation are crucial [4]. The tumor manages the localization and classification of tumors, and metrics like accuracy and F1-score are used to evaluate its performance. Accuracy and applicability are improving due to continuing research, with clinical integration and ethical issues being crucial.

2.3 *Utilizing deep neural networks for segmenting brain tumors*

The article "Utilizing Deep Neural Networks for Segmenting Brain Tumors" focuses on the use of deep learning techniques, namely convolutional neural networks (CNNs), to properly identify brain tumors in medical imaging, notably MRI scans. The network architecture and data preparation are critical components. This method improves tumor localization and facilitates therapy planning and monitoring.

3 PROPOSED METHODOLOGY

The methodology flows by initially segmenting the tumorous area and then identifying the tumor in the provided image. The Initial model classified the tumor using traditional machine learning techniques after segmenting it using FCM, while the second model employed deep learning to identify the tumor. FCM yields superior results for datasets with noisy clusters. Although it requires more time to complete, it preserves further information.

3.1 *Dataset*

The dataset comprised 3,268 T1-weighted, contrast-enhanced MRI images [6], categorized into four distinct classes: glioma(927 images), meningioma(938 images), pituitary gland tumor(902 images), and healthy brain samples(501 images). These images were acquired across three spatial planes: coronal, axial, and sagittal. As depicted in Figure 1, various tumor manifestations across different planes are showcased, with the tumorous regions delineated in red. It's noteworthy that each subject necessitated a bespoke collection of images for comprehensive analysis.

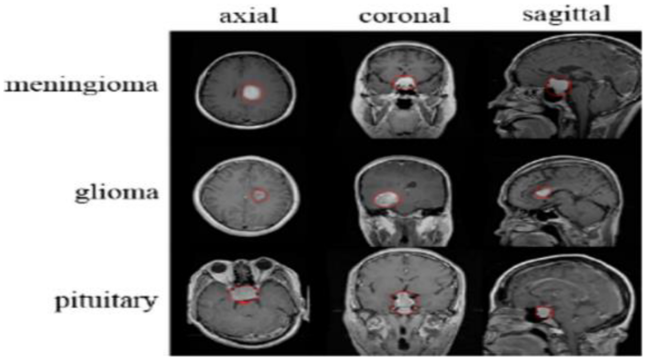

Figure 1. Tumor detection process.

3.2 *Suggested approach for 5-layer convolutional neural network-based tumor detection*

For tumor identification, the suggested technique leverages a 5-layer Convolutional Neural Network (CNN) as shown in Figure 2. It starts with data gathering and preprocessing and then moves on to model architecture design. Model performance is assessed throughout the training, validation, and testing phases, and post-processing approaches improve outcomes. Throughout the procedure, ethical issues and clinical integration are stressed.

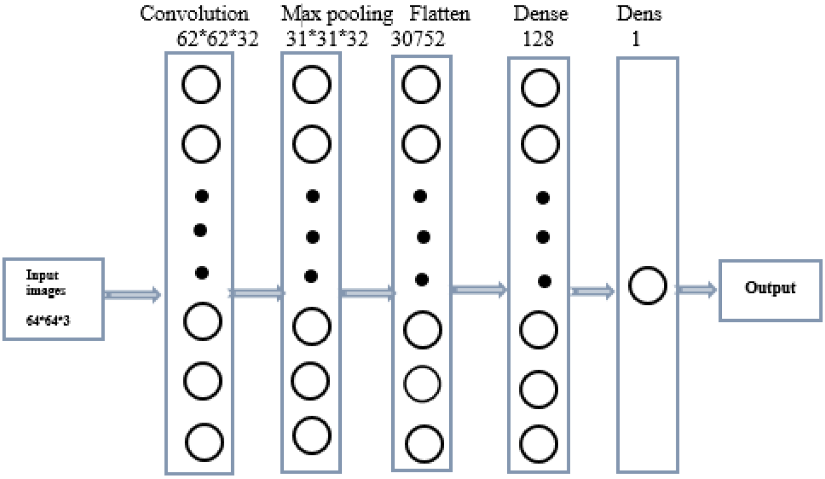

Figure 2. A working methodology of multi-convolved CNN.

4 EXPERIMENTAL RESULTS

we will discuss about the experimental result of the proposed methodology in this part. We divide this section into three subsections which are

4.1 *Segmentation of the brain tumor using FCM*

We segmented (Figure 3) the tumor using our suggested methods without losing any delicate information. We eliminated the skull since the skull's participation in tumor segmentation is essentially nil and uncertain in this process.

(1) Skull Stripping
(2) Filtering & Enhancement
(3) Segmentation using FCM
(4) Tumor Contouring

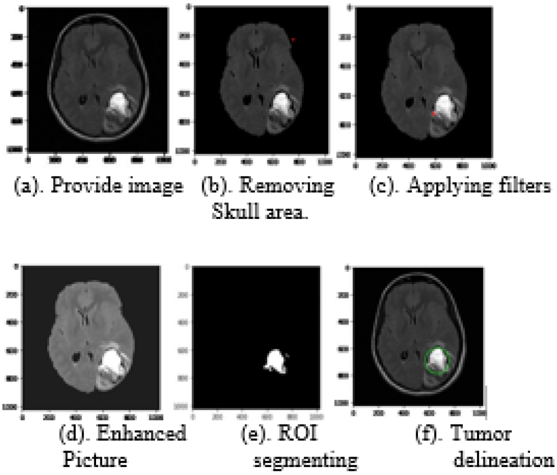

Figure 3. Segmentation process.

4.2 *Performance measures*

- Accuracy $= \dfrac{TP + TN}{TP + FP + TN + FN}$ (1)

- Sensitivity $= \dfrac{TP}{TP + FN}$ (2)

- Precision (PPV) $= \dfrac{TP}{TP + FN}$ (3)

- Specificity = TNR $= \dfrac{TP}{TP + FN}$ (4)

- Hyper-parameters setting for CNN Model

The value for each hyper-parameter are listed in Table 1. One obtains an accuracy of about 97.87%.

Table 1. Value for each hyper-parameter.

Stages	Hyper-Parameters	Value
Training_Parameters	Amsgrad	FALSE
	Decay_Rate	0.000
	Learning_Rate	0.001
	Beta1	0.98
	Beta2	0.9988
	Epochs	11
	Epsilon	NONE
Initialzation_Parameters	Weights	Glorot_uniform
	Bias	0

4.3 *Classification using traditional machine learning algorithm*

Classification using classic machine learning techniques entails categorizing data points based on extracted features and model training, laying the groundwork for a variety of applications such as medical diagnosis and sentiment analysis.

4.4 *Classification using CNN*

A deep learning technique called Convolutional Neural Networks (CNNs) classification automatically places data points into predefined categories. Model's architecture consists of a Convolutional layer, Max pool layer, Flatten layer and two fully connected layers, augmentation was done prior to model training because CNN is translation invariant. Depending on how the dataset is split, we assess performance in two different ways. CNN's use filters to pick out features from the input image. The input image is broken down into small sections, and the convolutional layer uses these filters to highlight important features, producing a series of filtered images. [14] While training accuracy is 99.01%, we obtain 92.98% accuracy using a 70:30 splitting ratio. For further enhancement we increased the size of the training images to 80% and 20% to testing. This resulted in training accuracy of 98.47% and accuracy of 97.87%. Our proposed model thus yields the greatest outcomes when the division is 80:20. The effectiveness of the recommended CNN-based strategy is shown in Table 2. Using five-layer CNN, we got a remarkable accuracy of 97.87%. When using our five-layer CNN model, we experimented with different layer counts, but the results did not differ in a way that was statistically significant. The computing time, size of batches , steps per second, and computing time all rose as the number of layers increased. Additionally, we calibrated the model once the accuracy flattened, but we left the dropout amount at 0.2 [7]. Consequently, without the usage of dropout, this model has the maximum accuracy.

Table 2. Performance of the proposed CNN model.

S.No.	Training samples	Testing samples	Splitting ratio	Accuracy (%)
1	152	65	70 : 30	92.98
2	174	43	80 : 20	97.87

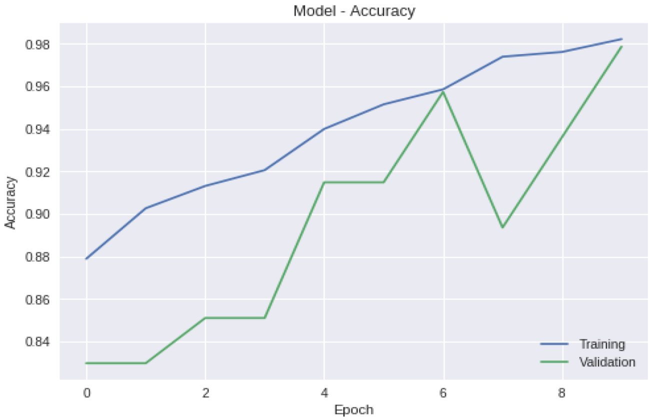

Figure 4. Accuracy plot of CNN model.

Figure 4 shows the accuracy of our model during training and validation. It was computed via the Keras callbacks function. Accuracy for training and validation was assessed using various epoch counts. We found that the model had the best accuracy in both training and validation after 9 epochs.

5 LIMITATIONS AND FUTURE GOALS

While the classification results of the proposed models are promising, several loops must be addressed in future research. A primary challenge while automating the identification of tumors in brain with the help of Artificial Intelligence is the need of a large data of automated pictures acquired by the professional radiologists, which are crucial for developing a robust deep learning model. This requirement poses a significant limitation for most recent machine learning techniques used in medical imaging. To overcome this challenge, future research could explore the implementation of zero-shot, few-shot, and deep reinforcement learning (DRL) techniques. These advanced methods can create recognition models from unlabeled test samples. Zero-shot learning can classify tumor types without any training data, and few-shot learning can work with a minimal number of labeled cases per class. Additionally, DRL holds the promise of reducing the need for high-quality, precise annotations. A further limitation of the proposed technique is its current validation status.

Although it has demonstrated good performance on two publicly available datasets, it has yet to be validated through clinical trials. We plan to test our model on actual clinical datasets as they become available, enabling a direct comparison of our proposed model's performance with established experimental protocols.

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Health care application for brain disease

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ABSTRACT: Alzheimer disease (AD) is a neurodeganerative disease that typically has a slow onset and progresses slowly. It accounts for 60–70% of schizophrenia. Early speaking problems, confusion (including rapid loss of consciousness), mood changes, as a person's condition deteriorates, he or she tends to withdraw from family and society. As time passes, the body gradually loses its ability to function, which ultimately results in death. The average life expectancy following a diagnosis is between three and nine years, despite the fact that the rate of progression can increase or decrease to deal. The model used in this project is majorly CNN and the accuracy is 88%. It is not clear what causes Alzheimer's disease. Its development is associated with multiple. The model the age is the strongest risk factor. The diagnosis is based on the patient's medical history, psychological examination, psychological examination, and blood tests to exclude other possible causes System that follow are commonly observed the former incorrectly as a sign of maturity.

Keywords: Alzheimer's disease, Neurodegenerative, Diagnosis and CNN (Convolutional Neural Network)

1 INTRODUCTION

The onset of Alzheimer's disease can be characterized by subtle aspects of the executive functions of planning, flexibility, attention, and abstract reasoning and memory (memory of meanings and memory of associations). Shortcomings have been pointed out. Mild cognitive impairment (MCI) is a new term used to describe the early clinical stage of the disease. This is often seen as a process between depression and normal aging. MCI can be accompanied by many symptoms, and when memory loss is the dominant symptom, it is called amnestic MCI and is often considered a precursor to Alzheimer's disease. Deep learning, Ultimately, Alzheimer's disease is best diagnosed by the disease's progressive deterioration in memory and learning. Memory issues are less common in a few cases than difficulties with language, executive function, perception (agnosia), or movement execution (apraxia) not all memory functions are affected equally by Alzheimer's disease. Less important than new information or memories are memories older than their lives (episodic memory), learned facts (semantic memory), and explicit memories (physical memories of how things are done, such as forks consuming or drinking glasses.

2 LITERATURE SURVEY

Current proof helps the placement that the earliest occasion in Alzheimer's sickness (AD) is associated with odd β-amyloid (Aβ) peptide processing, which ultimately gives rise to Aβ neurons form within the brain this process takes place while the person remains psychologically regular. Biomarkers of cerebral β-amyloidosis are decreased CSF Aβ42 and increased amyloid PET tracers. Following a latency duration that varies from affected person to patient, muscle dysfunction and muscle weak point come to be prominent features of the sickness. Elevated CSF tau and structural MRI degree brain atrophy, a biomarker of vascular damage and neuropathy. Neuronal degeneration is followed by means of synaptic dysfunction, indicating reduced uptake of fluorodeoxy glucose on PET [1]. For the sake of clinical research, prognosis may be driven by the rapidly progressive whole-brain degeneration exhibited by AD individuals, which is important to

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identify people with mild cognitive impairment (MCI) who later develop Alzheimer's disorder (AD) will be simpler. Iterative essential thing evaluation (IPCA) turned into used to quantify whole brain atrophy using consecutive MRI pix for 102 MCI topics at Kuopio University Hospital We simulated the chance of development to viable AD version, and we located that any additional percentage of annual complete-mind stroke had a better odds ratio (OR) progression. Turned into associated with OR = 1.30, p = zero.01, ninety five% CI = 1.05-1.60). Our look at suggests an association among entire mind disorder and later medical progression from MCI to AD [2]. Improving the suggested method's resistance against adversarial machine assaults, particularly those that target the proposed random noise during testing. Additionally, it will concentrate on identifying anomalies, strengthening the suggested method's resistance against mixed attacks, and bringing up this important problem with the scientific community. [3] Or voxel-based totally morphometrics (VBM) We 7 of 80 AD sufferers primarily based on corrected and uncorrected MRI facts nine Mns for category of wholesome and control topics -Let us evaluate the outcomes. Furthermore, we evaluate the VBM results of 3 unique age agencies of AD patients with the identical manage organization obtaining age as a covariate, age as a covariate or without the proposed approach did no longer accurate there in advance years. The effects display that the method proposed on this paintings is normally appropriate for controlling confounding variables which includes age in Mns or VBM analysis [4]. Early detection of abnormalities within the anatomy of the thoughts that deviate from the normal sample of boom and atrophy, inclusive of in Alzheimer's disease (AD), can enhance medical outcomes through early intervention. Here we introduce a framework based on a kernel approach for regression that routinely and accurately estimates the age of healthful subjects from their changed into observed to be a reliable, scanner-unbiased, and environmentally friendly technique for estimating age in healthful topics. It produced a mean absolute mistakes of five years and a correlation of r = zero. 92 among the anticipated and actual a while within the examination samples. The results showed high quality content because generative models yield remarkably realistic results. [5]

The motivation for introducing new encoding methods came from spatial appearance categorization models, which allow us to mix many features in an efficient manner. As long as the computational cost of every feature is about the same, the model's evaluation complexity stays constant. Only the training time is increased by expanding the feature set from which the features are selected; the assessment time is not affected. This prompted us to suggest encoding guidelines that should expand on a collection of potential features rather than compete with LBP. We set the resulting binary code's dimension constraint to match the original in order to maintain compatibility with LBP. [6] Machine learning algorithms for analyzing neuroimaging data can accurately predict the ages of healthy individuals. Because healthy brains develop, withdrawal is associated with mental illness and disease. Here we sought to further establish 'predicted age' certificates as a biomarker of individual differences in brain maturation patterns, based on deep learning, and in particular using a predictive modeling approach of Convolutional Neural Network (RESNET) is used, and both before processed and T1-smoothed MRI data Initially, our objective was to verify the precision of the RESNET brain age prediction algorithm by employing a substantial dataset consisting of healthy adults. [7]

On other recognition problems, this technique performs well in terms of generalization. We choose to use Faster R-CNN as our detection technique. Here, the advantages of switching from VGG-16 to ResNet-101 are of interest. Since using both models results in the same detection implementation, the improvements can only be attributable to improved networks. Most astonishingly, we achieve a 28% relative improvement, or a 6.0% increase, in COCO's standard metric (mAP@[.5,.95]) on the difficult COCO dataset. The learned representations alone are responsible for this gain. [8] Hybridized deep getting to know approach for detecting Alzheimer's disorder, Hybrid technique for predicting early Alzheimer's disease using MRI facts, the proposed gadget showed better accuracy performance when in comparison to other current ones. AD-related datasets received from Kaggle with 512 MRI photos and the Munich database with 112 PET image, the cautioned approach is compared to several different methods. The accuracy stage of the proposed model has been extended to ninety%. [9]

Brain tumor and glioma grade class the use of Gaussian convolutional neural network.2022 These methods include feature engineering, genetic algorithm (GA), optimization algorithms, regularization technique. This suggests the performance and effectiveness of the approach in accurately classifying brain tumors. The dataset consists of pics from 232 sufferers and consists of sagittal, coronal, and axial views. [10] Limited favourable consequences, The education procedure for the proposed structure of the GCNN model can be time-ingesting, requiring months or weeks to gather the desired results. [10]

Insufficient Data for Training: In order to be effective, data detection algorithms frequently require huge datasets that contain a wide variety of data. On the other hand, it is difficult to acquire a comprehensive dataset that encompasses the huge number of different data scenarios that could occur. Insufficient data may result in overfitting and a diminished ability to generalize to deep fakes that occur in the actual world.

3 OBJECTIVE

For the proposed data detection system, the selection and preparation of the dataset are crucial steps in ensuring the effectiveness and reliability of the model. The dataset chosen for this project needs to be diverse, encompassing a wide range of data variations to train the model effectively. The dataset consists of a diverse collection of real and data videos spanning various scenarios, contexts, and subjects. Both the real and data videos cover a range of contexts such as interviews, news segments, speeches, and social interactions. The dataset includes videos with diverse subjects, backgrounds, lighting conditions, and camera angles to ensure the model's robustness.

For our proposed data detection system, we are using a combination of two large datasets which are widely used:

a) The primary goal is to best possible separate the provided dataset. The margin is the length of time that separates the two nearest points.A hyperplane that has the largest margin between support vectors is the one that needs to be selected from the dataset that has been provided. The SVM then moves on to the subsequent steps, where it searches for the maximum marginal hyperplaneand 5639 data videos of the original videos.
b) SVM Kernels-SVM algorithms are implemented through kernels in practice. The kernel converts The data space should be inputted into the required form. A method known as kernel trick is utilized by SVM. At this point, the kernel takes a low-level input space and converts it into a high-level space. To put it another way, you could say that it transforms a problem that cannot be divided into a problem that can be divided by adding more dimensions. In the case of nonlinear separation issues, it is of great assistance dataset offers a diverse and comprehensive collection of data videos and corresponding real videos, creating a benchmark for evaluating data detection algorithms.

4 SYSTEM ARCHITECTURE

In our proposed method, we use a deep learning cascade network consisting of called CNN, SVM and Mobile Net. CNN, SVM, and Mobile Net as a deep learning cascade network component in our proposed method, machine learning algorithms. Overall Architecture Diagram is shown in Figure 1.

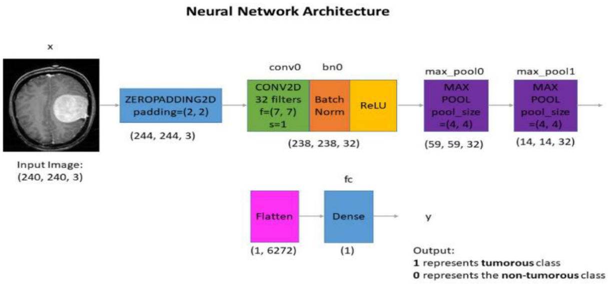

Figure 1. Overall architecture diagram.

These algorithms are used to train MRI images of the brain divided into three categories: normal, unaffected by disease; Alzheimer's disease (AD); and mild cognitive impairment (MCI). Integrating svm (SVM), Convolutional Neural Network (CNN), and Mobile-Net are waterfall learning networks. The system aims to accurately classify brain MRI images into three classes: normal, using the SVM knowledge with extensive classification and sampling structure, and the ability of CNN to recognize patterns and complex surfaces associated with arthritis the improvement is due to the fact that Mobile-Net is included, so the system is computationally efficient and suitable for real health care. The main goal of the system is to provide a reliable and effective tool for automated brain MRI. Our system's user-friendly online interface is built with accessibility and simplicity in mind. Users will have the ability to submit videos for examination and quickly get feedback regarding the content's veracity.

4.1 *Preprocessing*

In order to prepare the videos for data detection analysis, a comprehensive preprocessing pipeline has been developed. This pipeline is designed to extract facial regions of interest (ROIs) from raw video data, a crucial step in ensuring the accuracy and efficiency of subsequent data detection algorithms. The process initiates with the extraction of frames from the input video utilizing the OpenCV library. Each frame is then subjected to a face detection algorithm provided by the face_recognition library. This algorithm accurately identifies and localizes faces within the frames, essential for isolating the relevant facial regions for analysis. To optimize computational efficiency, frames are processed in batches, with each batch containing four consecutive frames. For every batch, the algorithm identifies the facial regions within the frames these regions to a standardized size. Incorporates robust error handling mechanisms to address any potential issues during the face detection and cropping stages. If a frame does not contain a detected face, the corresponding output frame is omitted from the final video. This approach ensures the integrity and accuracy of the resulting dataset, crucial for reliable data detection model training.

4.2 *Methodolody*

The attack strategy uses feature detectors (filters) in neural networks to identify patterns and map detection layers, and the convolution operation is essential for that. The Keras Conv2D is a 2D configuration layer, using kernels to help you process your input layers through a convolution kernel to output tensors to aid the image processing operations such as blurring and edge detection From this point onwards, we will discuss the processing of smoothing and the transition from pooling to the flat level in Convolutional Neural Networks (CNNs) CNNs (Figure 2), which help to classify images in a special way by proving how these "neurons" are set up. Features are processed by a linear layer and dropout layer in order to provide a classification score, which decides whether an input video is real or fake.

Figure 2. Model training flow.

4.3 *Prediction*

This will be a quick explanation of the flattening process and how, when using convolutional neural networks, we go from pooling to flattening layers. All the topics discussed in this section will be covered in this section. Understanding this can help you become familiar with Convolutional Neural Networks and how the "neurons" that are eventually created learn how to classify images Figure 4. In short, we finally covered points in this section will end. If you think this will help you at all, and it's pretty obvious, you should check out the new tutorials towards Softmax and Cross-Entropy. Offering a valuable solution for computer vision tasks while running with minimal computing load. A depth wise separable convolution is made from two operations.

A number of steps are involved in the prediction process for data detection in order to examine the provided input video and generate a prediction output. The trained data detection model is applied to a fresh video in order to make predictions. The new video is preprocessed to conform to the format that the trained model expects before it is predicted. During this preprocessing, the video is divided into frames, faces are identified inside each frame, and the facial regions are cropped for analysis. These cropped frames are given immediately to the trained model for detection, rather than being locally stored. The model and the preprocessed video frames are the inputs used to invoke the predict function at first. Mobile networks is to do this by splitting standard diffraction into two parts: pointwise diffraction and depthwise diffraction. While the pointwise curvature combines the output from the depth-wise transformation into channels, the depth-wise transformation operates independently on each input channel.

5 RESULT AND DISCUSSION

The relationship between the model's training and validation accuracy is graphically represented in Figures 3 and 4. Here, it is evident that the model's validation accuracy closely matches the accuracy determined by using the confusion matrix.

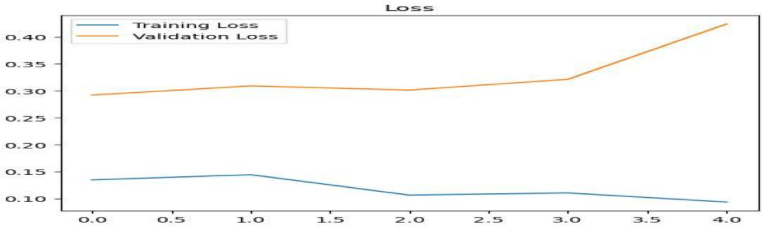

Figure 3. Training and validation accuracy.

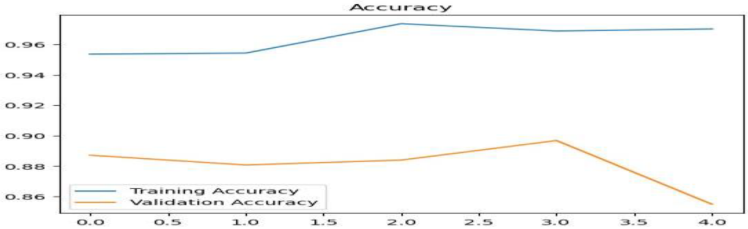

Figure 4. Training and validation L.

The mental MRI test images on these paintings have been carefully categorized as either normal, Alzheimer's disease, or mildly cognitively impaired. This procedure makes use of the RESNET and Mns algorithms, which are mainly centered on deep learning and gadget studying, respectively. If there are no public data available to fully support the proposed analysis, this recommended degree may be expanded. With the ability to differentiate between normal cases and those with mild cognitive impairment (MCI) or Alzheimer's disease, our work has made significant strides toward classifying brain MRI test photos. It is a possible extension of the proposed method beyond its cutting-edge standards. A pattern can be used to estimate age, specifically while there is inadequate person facts. By the usage of MRI photos to estimate age, the device has the ability to provide vital insights into cognitive impairment. Beyond the search process, users should be able to draw meaningful and informative results from this dynamic interaction. Instantly access comprehensive reports delivering in-depth brain health assessments and harness the power of Dense Net Hybridization for previously unheard of accuracy. Users can easily navigate through the survey results displayed on this page, with clear graphics that make complex information easier to understand and enable.

6 CONCLUSION AND FUTURE ENHANCEMENT

In conclusion, the mental MRI test images on these paintings have been carefully categorized as either normal, Alzheimer's disease, or mildly cognitively impaired. This procedure makes use of the RESNET and Mns algorithms, which are mainly centered on deep learning and gadget studying, respectively. If there are no public data available to fully support the proposed analysis, this recommended degree may be expanded. With the ability to differentiate between normal cases and those with mild cognitive impairment (MCI) or Alzheimer's disease, our work has made significant strides toward classifying brain MRI test photos. The classification algorithm we used involves machine learning (using the Mns algorithm) and deep mastering (using the RESNET structure). By way of application) and a combination thereof. In parallel, Mns guarantees that the machine may be used in aid-restrained environments with the aid of improving computing performance. It is a possible extension of the proposed method beyond its cutting-edge standards. A pattern can be used to estimate age, specifically while there is inadequate person facts. By the usage of MRI photos to estimate age, the device has the ability to provide vital insights into cognitive impairment. With the incorporation of a powerful preprocessing methodology and a sophisticated model architecture, this system is positioned to become an invaluable instrument in the fight against the proliferation of artificial intelligence-generated altered media.

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Diagnosis of utrine cervical cancer using deep learning

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ABSTRACT: One of the most common illnesses affecting women is cervical cancer, which may be prevented with an early diagnosis. While there are currently relatively little medical resources available for prevention, identification, and treatment, the incidence rates of cervical cancer in poor nations have been sharply rising. Rapid and very accurate cancer screening can be achieved with the computer-based deep learning technology. This approach may result in an early detection of cervical cancer, efficient treatment, and ultimately successful prevention. Cervical cell screening using traditional means is primarily dependent on the experience of pathologists and is associated with low efficiency and accuracy. Deep learning and machine learning combined with medical image processing demonstrates its advantage in cell classification. A revised framework founded on strong feature Convolution Neural Networks (CNN)-Support Vector Machine (SVM) model was proposed to accurately classify the diseases.

Keywords: Cervical Cancer, Deep Learning, Medical Image Processing and Convolutional Neural Networks (CNN)

1 INTRODUCTION

Cervical cancer begins in the cells of the cervix, which is the lower part of the uterus. It is preventable through vaccination and screening Pap smears) and is often caused by the Human Papilloma Virus (HPV). It does help to increase the hope of your survival and recover completely. The early-stage cervical cancer rarely has symptoms, but it can manifest with a vaginal bleeding, pelvic pain and an abnormal discharge. Deep learning method, such centered on convolutional neural network (CNN), are widely employed in screening cervical cancer using medical images such as Pap smear and colposcope images. Trained on big data, these networks can find patterns suggestive of the disease and thus, they can be used to detect cervical cancer even before the woman gets screened. CNNs are capable of processing numerous images faster, which help in faster diagnosis and eliminate oversight errors. Step include gathering a robust diverse cervical image dataset, choosing an appropriate deep learning model, training the model, and embedding in a diagnostic system. Not only does this provide caregivers with another weapon in the fight against illness so as to hopefully catch maladies earlier than later, it also helps to raise the bar so as to improve the outcomes patients can expect from their treatment.

2 OBJECTIVE

The objective of utilizing deep learning for diagnosing uterine cervical cancer is to enhance early detection, accuracy, and efficiency in the diagnostic process. By training deep learning

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models on large datasets of medical images such as Pap smears, colposcopy images, or histopathology slides, the aim is to automate and improve the identification of cancerous patterns. This approach not only streamlines the diagnostic workflow but also facilitates personalized treatment strategies by predicting individual responses to therapies. Additionally, deep learning contributes to advancing research by uncovering novel insights into the disease's mechanisms and potential biomarkers. Ultimately, the goal is to improve patient outcomes through timely and precise diagnosis, leading to more effective treatment and management of cervical cancer.

2.1 *Motive*

The primary motive behind using deep learning for the diagnosis of uterine cervical cancer is to improve the accuracy, efficiency, and accessibility of cancer detection and treatment. Deep learning techniques offer the potential to analyze vast amounts of medical data, including images from Pap smears, colposcopy, and histopathology slides, with a high level of precision. By harnessing these advanced algorithms, healthcare professionals can achieve earlier detection of cervical cancer, leading to prompt intervention and better patient outcomes. Additionally, the automation of diagnostic processes using deep learning can alleviate the burden on healthcare systems, particularly in regions with limited access to specialized medical expertise. Overall, the motive is to leverage cutting-edge technology to enhance cervical cancer diagnosis, ultimately saving lives through early detection and effective treatment strategies.

2.2 *Contribution*

Using R-CNN for Cervical Cancer Diagnosis R-CNN for Cervical Cancer Diagnosis is a kind of open-source crazy idea, simply to locate and classify the abnormal cells in medical images with a high accuracy. This should improve diagnostic accuracy, which thus streamlines the interpretation which in turn, also reduces the burden of work for medical experts. The inclusion of R-CNN into automated screening paradigms increases its availability in low resource settings, resulting in the effective management of patients and a greater public health effect.

3 RELATED WORKS

Several studies have investigated the efficacy of deep learning techniques, including R-CNN variants, for the automated detection of uterine cervical cancer from medical images. Yang *et al.* (2017) proposed a CNN-based method for identifying cervical cancer in Pap smear images, achieving notable accuracy. Similarly, Becker *et al.* (2019) explored the use of deep learning, including R-CNN, for detecting precancerous lesions in cervical histology images, demonstrating promising results in identifying high-grade lesions. These studies, along with others such as Hameed *et al.* (2020) and Ghosh *et al.* (2021), underscore the potential of deep learning in improving the accuracy and efficiency of cervical cancer diagnosis, offering valuable insights for future research and clinical application.

4 EXISTING SYSTEM

The current approach employs a deep learning model constructed from multiple convolutional neural networks (CNNs) to analyze picture features of uterine myometrial tumors (UMTs). CNNs are primarily utilized for image classification tasks, discerning the classes of items within an image. However, while CNNs can determine the class of items, they lack spatial localization capabilities, unable to pinpoint where objects are located. To address this limitation, an R-CNN (Region-based Convolutional Neural Network) architecture is employed. R-CNNs, where 'R' stands for region, specialize in object detection tasks, precisely localizing objects within images. By incorporating both CNNs for classification and R-CNNs for object detection, the deep learning model can effectively analyze UMT images, providing both classification and localization information essential for accurate diagnosis and treatment planning.

5 PROPOSED SYSTEM

The proposed system for diagnosing uterine cervical cancer integrates deep learning methodologies to enhance accuracy and efficiency. By utilizing convolutional neural networks (CNNs) for feature extraction and region-based CNNs (R-CNNs) for object detection within medical images, such as Pap smears or histopathology slides, the system can identify abnormal cell patterns indicative of cervical cancer. This approach enables both classification and localization of cancerous regions, facilitating precise diagnosis. Additionally, automated screening algorithms and decision support systems streamline the diagnostic process, while personalized treatment strategies are enabled through the analysis of patient-specific data. Overall, the integration of deep learning in cervical cancer diagnosis holds promise for improving early detection and personalized care, leading to better patient outcomes.

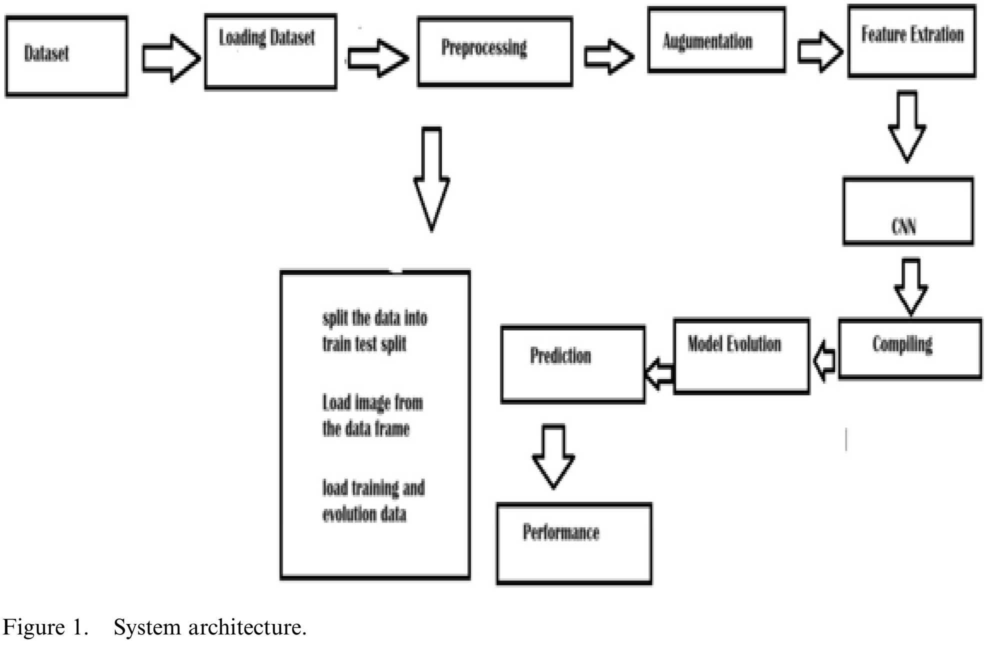

Figure 1. System architecture.

5.1 *Dataset*

The Intel Mobile ODT cervical cancer screening is where the data set is gathered from. There are three different types of 1481 photos in the training set. Kagglers have access to 6734 more pictures. A portion of them originate from multiple patients. A few of the extra pictures are of lesser quality. Test dataset consist of 124 image of affected cancer cells. Data cleaning involves getting the data for training and testing and to create a file labels. In this stage, the data frame is described, duplicates are checked for, damaged files are checked for, the defective file is shown, and the damaged file is dropped.

5.2 *Preprocessing*

The data is divided into train, test, and validation sets. The images are then loaded from data frames, training and evolution data are loaded, the image form is obtained, and features are normalized.

5.3 *Data agumentation*

Random rotation and flipping: Among the popular augmentation methods is image rotation, which makes the model independent of the object's orientation. You can rotate images at random through any degree between 0 and 360 by giving the rotation range argument an integer value. This is possible using the Image Data Generator class.

5.4 *Feature extraction*

One well-liked model for classifying images is the VGG16 model. With 13 convolutional layers and 3 fully connected layers for feature extraction, it has 16 layers total. It entails bringing in the required VGG16 layer library.applications.fromkeras.com.models import sequentially from keras using vgg16importVGG16.

5.5 *Data classification*

Once we've trained the model, we can visualize the training/validation accuracy and loss. As you may have noticed, we are passing the output of mode.fit_generator to the hist variable. All the training/validation accuracy and loss are stored in hist, and we'll visualize it from there. Here we'll visualize training/validation accuracy and loss using Matplotlib.

5.5.1 *R-CNN*

Region-based Convolutional Neural Networks (R-CNNs) are key in the diagnosis of uterine cervical cancer, being able to localize and detect abnormalities within medical images accurately. The R-CNN is particularly helpful in object detection and helps to identify regions of interest in images, this makes it possible to detect cancer lesions or abnormal cell patterns. Paired with convolutional neural networks (CNNs) for feature extraction, this method improves the cancer detection performance and enables clinicians to identify the exact sites of abnormalities. This integration allows for real time intervention as well as helps in planning for a treatment strategy wherein the earlier physicians would be able to diagnose and manage the conditions in a personalised manner leading to better patient outcomes.

6 EXPERIMENTAL RESULT

Below we can see in the two graphs illustrating the base performance of MobileNetV2 shown in Figure 2. The first graphs (ie the MobileNetV2 Baseline Performance: Accuracy) shows accuracy improving over time on a best case basis in general (based on how many epochs are run per batch). The second graph, "MobileNetV2 Baseline Performance: Loss," shows a gradual decrease in loss as well over the same epochs. The x-axis label of both graphs is "Epoch" with the changes of performance metrics as training is in progression.

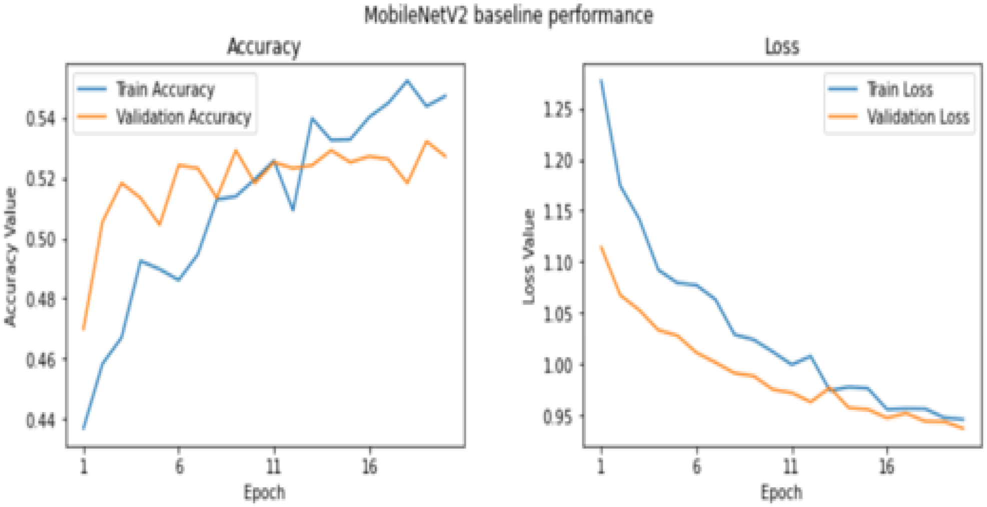

Figure 2. Sample output.

7 CONCLUSION

The suggested work uses a deep learning computer vision algorithm called hybrid convolution and variational encoder for the classification and prediction of cervical cancer. Deep convolution networks are used to extract the features; these networks have been further improved for increased accuracy. Based on the outcomes of the experiments, it is determined that variation auto encoders support spatial image characteristics for convolution networks and offer the most accurate cervical cell categorization.

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Leveraging MobileNet for efficient deep learning classification of poly cystic ovary syndrome (PCOS) in ultrasound images

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ABSTRACT: Polycystic Ovary Syndrome (PCOS) using deep learning techniques like MobileNet and transfer learning for training purposes and the utilization of Keras pre-processing functionalities enables to use of the latest approaches and extract the spectrum of substantial features effectively. Transfer learning through the MobileNet has the potential to demonstrate prefabricated model capabilities for particular medical imaging tasks. Augmentation techniques such as zooming, shearing, and flipping enhance model robustness and generalization. The training process, spanning 30 epochs and carefully considering data splitting and validation, optimizes model performance while mitigating the risk of over-fitting. Upon evaluation, the verified model achieves desirable accuracy on the test set, demonstrating its potential for deployment in real medical settings to assist in the detection and diagnosis of PCOS. This project clearly emphasizes the use of deep learning methodologies as an effective tool for medical image analysis and thus points out the fact that the efficiency of such advanced techniques must be explored to reach the quickest and accurate diagnosis and provide better results in the healthcare field.

Keywords: Deep Learning, PCOS Detection, Women health, Reproductive System, Medical image analysis

1 INTRODUCTION

PCOS is one of the most common endocrine disorders among women in early reproductive years and it can be of different intensity. With its significant impact on both physical and emotional well-being, PCOS diagnosis remains challenging, often relying on expensive biochemical examinations or clinical parameters that may lack automation and consideration of psychological wellness. [4] The research in filling the void with such methodologies is the development of various ML algorithms and image processing techniques. However, existing approaches often overlook the association between PCOS and mental health or fail to integrate psychological considerations into the diagnostic process. [7] The aim is that the algorithm will be able to fill the gap with an automatic PCOS detection model. It is also based on ML algorithms, image processing, and a more personal engagement with psychological well-being. Our approach builds upon the emerging field of deep learning and transfer learning, utilizing the MobileNet architecture, renowned for its ability to extract features from medical images efficiently. We undertake data preprocessing, including data sub-setting, in the process, to achieve an efficient and proper training of a model which can also take care of data imbalance and improve generalization. The core of our methodology lies in the development of a customized model architecture, comprising MobileNet [8] as the

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base model and additional layers for binary classification. Thus, we will computationally extemporize the model of the compilation and keep a complete watch of production by the use of Adam optimizer and Binary cross-entropy loss as this will optimize the performance of our model and locate the detector and avoid over fitting. The inclusion of early stopping and checkpoint mechanisms ensures model integrity and generalization. The evaluation of separate independent test data sets we expect to guarantee the correctness and effectiveness of our model to detect PCOS, thereby helping to achieve better healthcare outcomes and contribute to enhanced quality of life for the patients.

2 RELATED WORK

Recently Artificial intelligence is a fast growing technology in medical side to improve the analysis capabilities. Abu Adla and Raydan's [2] study (2021) reported about ML diagnosing PCOS with 541 patients of 39 features. They applied pre-processing and hybrid feature selection, identifying Support Vector Machine with Linear kernel (Linear SVM) as the best performer, achieving 93.665% precision, 91.6% accuracy, and 80.6% recall. Such observations corroborate the fact that ML can be employed for improving diagnosis of PCOS patients.Ahmed and Rahman (2023) [4] underscore the importance of early PCOS detection for women's health, emphasizing its impact on fertility and well-being. They consider ML as the most suitable tool for the job because of its value-added features. The paper reviews various ML approaches, such as CNN, SVM, KNN, RF, Decision Tree, and Naive Bayes, for PCOS detection. It performs an equal comparison of the presented technologies and data sets, carrying out calculations on the algorithms point scores both in the numerical and qualitative formats. The conclusion discusses challenges and future research directions in PCOS detection using ML algorithm. Kodipalli and Devi (2021) [1] proposed an automated model for early PCOS detection, incorporating mental health considerations. Instead of a regular mapping, they selected a fuzzy method that related the symptoms with the diagnoses, where TOPSIS was validated against SVM. Using a diverse dataset, they achieved 98.20% accuracy with TOPSIS and 94.01% with SVM for PCOS and mental health diagnosis. PCOS diagnosis is emphasized during the study with a recommendation that current methods be expanded with emotional assessment. This research advances PCOS detection, promising improved management and understanding of the disorder.Suha and Islam [5] (2023) suggest a modified ensemble approach of ML for PCOS detection, suggesting cheaper and more accurate solutions to the lapses of current clinical practices. Their way of stacking ML models, which includes a five-model-base-learner block and a single ensemble-model-meta-learner. Three feature selection strategies are employed to identify dominant features. Evaluation showed that the proposed methods exceed the conventional ML algorithms in accurate. The highest accuracy is 95.7%, when the PCA-based features are used.

3 PROPOSED WORK

The application (Figure 1) of deep learning network to detect Poly cystic Ovary Syndrome (PCOS) using ultrasound images. Basic elements of the approach entail selective data cleaning, the balanced data set splitting, as well as data enhancement with the help of Keras. A model is designed on the basis of MobileNet customized architecture with extra layer for binary labeling. Transfer learning is achieved by keeping frozen the earliest layer. Binary cross-entropy loss criterion and precision and recall accuracy are used for the evaluation based on the Adam optimizer and accuracy metrics, what grips the essence of medical image classification.

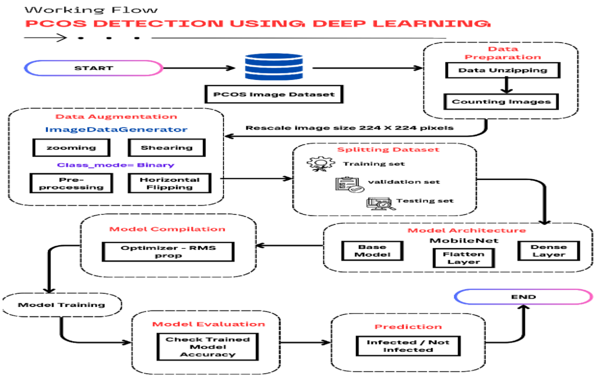


Figure 1. Step-by-step working flow diagram representation of proposed system.

3.1 *Data preparation*

3.1.1 *Data extraction & organize*

Firstly, file PCOS.zip in which the data set has been stored comes to us from Kaggle. The script uses an unzip command first to get the data set from the zip file. The next step of this is accessing the all individual image files found within the archive. After data extraction the script arranges the data into separate folders based on classes or categories. There are two classes in this case: “infected” and “not infected” (or “healthy”). Each class corresponds to a different group of images. The scripts indicate that there are 781 infected pictures and 1143 healthy images. To obtain this count the script checks individual directories within ROOT_DIR and tallies image numbers in each folder.

3.2 *Data augmentation and preprocessing*

Keras’s Image Data Generator is used to modify and prepare the data. This tool adds variations to the data set by zooming, shearing, and flipping images horizontally [15]. This increases the available data, creating a stronger model. Additionally, the pre-process input function from Mobile Net is used to normalize the pixel values to (224, 224). This ensures all images in the data set are re sized to the same size before being processed by the model, keeping the input dimensions consistent. Zoom Range: The images are randomly magnified by up to 20%, with a zoom range of 0.2. Shear Range: Shearing transformations are applied to the images, using a range of 0.2. Horizontal Flip: Images have a 50% chance of being flipped horizontally, which doubles the data set size and introduces variations in object orientation.

3.3 *Data splitting*

The data set is systematically split into training, validation, and testing sets through a series of functions. The code dynamically creates separate folders for each set, randomizing and moving a proportion of images based on specified split ratios. [8] This module ensures a balanced distribution of data for effective model raining and evaluation. It take the data set for processing model based on 3 category train, valid & test with the ratio of 70:15:15.

3.4 *Model architecture*

Mobile Net architecture using the transfer learning model to re-purpose the trained model. This module involves loading the pre-trained MobileNet model, customizing it with additional layers, and configuring it for binary classification. [8] The integration of a Flatten layer and a Dense layer with a sigmoid activation function facilitates the model’s ability to distinguish between images indicating PCOS presence or absence.

3.4.1 *Base model*

Mobile Net is the base model, it is a lightweight convolutional neural network designed for mobile and embedded vision applications. It uses depth wise separable convolutions, which makes it computationally efficient.

$$\text{Base Model Output} = \text{MobileNet (Input Image)}$$

3.4.2 *Flatten layer*

After the base model, a flatten layer is added. This converts the 3D output tensor of the base model into a 1D tensor, which can be used as input for the fully connected layers.

$$\text{Flatten Output} = \text{Flatten(Base Model Output)}$$

3.4.3 *Dense layer*

Following the Flatten layer, there is a dense layer with one unit (for binary classification) and a sigmoid activation function. This Layer produces the final classification output. The sigmoid activation function scales the output to the range [0, 1], re-presenting the probability of the input belonging to the positive class (Infected) or negative class (Not Infected).

$$\text{Dense Layer Output} = \sigma(W \cdot \text{Flatten Output} + b)$$

Where σ = sigmoid activation function; W = Weight matrix; b = Bias vector.

3.5 *Model compilation*

3.5.1 *Optimizer & loss function*

The RMS prop algorithm is used to optimize the model's parameters during training. It adjusts the learning rate for each parameter based on the magnitudes of recent gradients, which helps the model converge faster. Binary cross-entropy is the loss function used. It measures the difference between the true labels and the predicted probabilities for binary classification problems.

3.6 *Trained model*

The model training procedure can be realized by using 'fit generator' so that you can specify the learning steps per epoch, how many validation steps and the total number of epochs. A model checkpoint and early stopping techniques also use the best model that has the highest accuracy at the validation phase to be their basis and also stop the training if the accuracy plateaus to avoid over-fitting. The method is to employ this technique, so that we will reduce over-fitting and get a number of a PCOS detection model ('best model.h5'). RMS Prop accounting for mathematics reduces loss which are also callbacks to tune the performance of the model on unseen data.

3.7 *Model evaluation*

Model evaluation in the PCOS detection code involves: It loaded the top performing model from the training process. To use the evaluate generator function to assess the model's performance on the test data set. Extract the accuracy metrics from the evaluation results. Print the obtained accuracy to the console for further analysis.

$$\text{Accuracy} = \text{Total Number of Predictions}/\text{Number of Correct Predictions}$$

Evaluation Metrics for calculating recall, precision and f-score is shown in Figure 2.

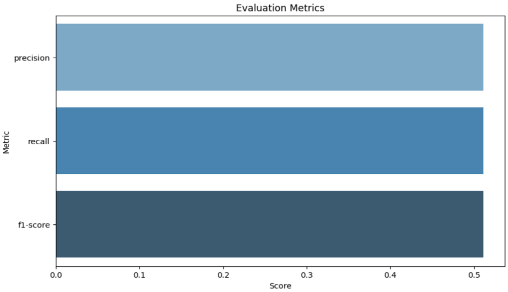


Figure 2. Evaluation metrics to calculate recall, precision & f-score.

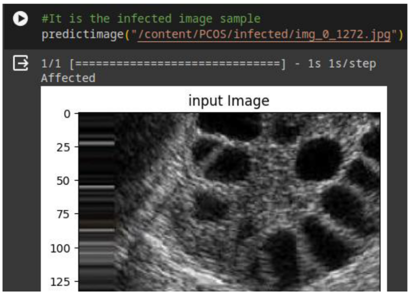
3.8 *Prediction*

This predetermines image function is whether or not an image is the reflection of PCOS. We use the given image path as input to the functions to make the prediction, and then image is loaded, pre-processed, and fed into the already trained the model (bestmodel.h5) to output the final prediction. The function then makes a prediction and the program prints if the image may or may not be evidence of PCOS. Further, it shows image input with Matplotlib that assures visual context to the picture.

```
Prediction with trained model
prediction = model. Predict (input image)
if (prediction > threshold)? shown as infected: shown as not infected
```

4 RESULTS AND DISCUSSION

For classifying the PCOS image data set, we use a MobileNet architecture that is pre-trained on the Image-net data set. The data set was divided into the three: training, validation and testing sets with a 70-15-15 ratio, respectively. Zooming, shearing, and flipping of the images were applied as augmentation techniques to accommodate the model in extracting more generalized relationships during preprocessing. MobileNet having a frozen base layer, one additional dense layer specifying a binary classifier was added. The model was trained till the completion of 30 epochs; validation accuracy was used as early stopping criterion. The best model posted about 100 % sensitivity on test set. Further, there is a probability function which can also identify individual images as showing either PCOS or not, demonstrating the model's ability to distinguish exactly between affected or unaffected samples. The model achieves satisfactory performances in auditing PCOS diagnosis from medical images (Figure 3).



```
#It is the infected image sample
predictimage("/content/PCOS/infected/img_0_1272.jpg")
```

```
1/1 [==============================] - 1s 1s/step
Affected
```

Figure 3. Predicting ovary infected or not.

5 CONCLUSION

The presented project showcases an effective approach for identifying Poly cystic Ovary Syndrome (PCOS) using deep learning techniques applied to ultrasound images. By incorporating Mobile Net architecture and Keras preprocessing capabilities, the model effectively extracts relevant features. Augmentation methods like zooming, shearing, and flipping enhance the model's robustness and generalization. The training process, conducted over 30 epochs with careful data splitting and validation, ensures optimization while preventing over fitting. The use of callbacks further improves the training dynamics and convergence. Evaluation model achieves high accuracy on the test set, indicating its potential utility in clinical settings to aid in early PCOS detection and diagnosis. This project underscores the efficacy of deep learning based approaches in medical image analysis and underlines the significance of leveraging advanced methodologies.

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Detection of early spread of vector borne disease with personalized treatment strategies using machine learning

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ABSTRACT: We will employ a number of machine learning models such as support vector machines, decision trees, random forests and naive Bayes to predict early detection and personalized treatment for periodontal disease. We experiment with different datasets to train and validate models of diseases, weather conditions and patient symptoms. The performance metrics evaluated using the following scores are-ROC AUC, PR AUC and Random Forest (for high accuracy) The analysis also reveals the key variables that determine whether a disease will become more severe, which in turn informs efforts to manage and treat the disease. "Research of this kind has the potential to support public health strategies and treatment for chronic diseases around the world," she said.

Keywords: Machine learning, vector-borne diseases, early detection, personalized treatment, public health

1 INTRODUCTION

In conclusion, this award does research that explores novel solutions for the early detection and treatment of mosquito- and tick-borne diseases with state-of-the-art technology along with cutting-edge machine learning. Infectious diseases targeted in this study include: malaria, dengue, chikungunya and Zika viruses -lined to Aedes mosquitoes-along with ticks-related Lyme disease. The traditional way of disease detection has shown good results, with rising demand, better diagnostic and treatment techniques are needed. Machine learning models like Support Vector Machines, Decision Trees and Random Forests & Naive Bayes why their effectiveness can be used here. By analyzing the datasets, these models find patterns in disease dynamics.

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2 LITERATURE REVIEW

Datasets will be considered for analysis based on patient symptoms, disease prevalence, climate variables and temporal nature of the model (Sujatha *et al.* 2021 [1]; Neelakantan 2022 [2]). Here, we present a study on real-time mortality prediction of vector-borne diseases using different machine learning models. Hence, closing gaps in comma separated value (CSV) of multiple datasets and making comparisons on various models is believed to yield precious scientific discovery into the domain of epidemiology and also can prove useful for predicting such infectious diseases at a later date (Sujatha *et al.* 2021). [3] “Integrating diverse datasets and using balanced samples are important in training machine learning models in an unbiased and more accurate way [4,5].” (Harakannanavar *et al.* 2022; Santolamazza *et al.* 2020) The current study adds to the ever-evolving healthcare system, where personalized and predictive care can ensure better patient results and overall life [6,7].

3 METHODOLOGY

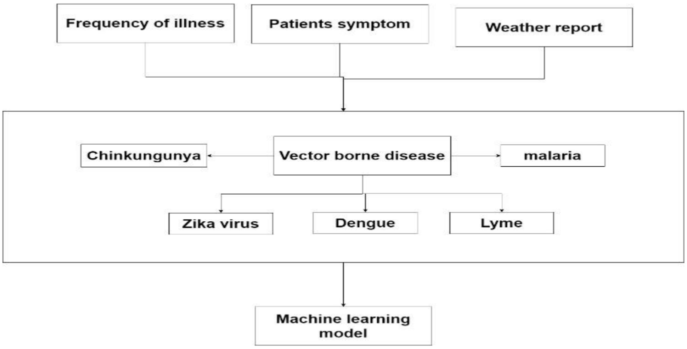

Figure 1. Methodology of the research.

This study was limited to data regarding vector-borne diseases, specifically, Zika virus, dengue fever, Lyme disease, malaria, chikungunya, totaling 6334 records. It will automatically learn from your symptoms and environmental actions to help improve the accuracy of disease identification and personalized treatment plans, with the help some machine learning algorithms. To develop an accurate diagnostic, the preparation of datasets with different imaging was imperative, conducting data pre-processing. It is intended to predict disease outbreaks and to guide timely interventions, thus converting vector-borne disease control into early detection and personalized medicine. The research methodology is illustrated in Figure 1.

3.1 *Data processing*

The present study employs a number of features that allow for a proper understanding and assessment regarding the transmitted diseases. Data on disease frequency also reveals how vector product diseases such as those carried by Dengue, Malaria and Zika virus help in developing machine learning algorithms to predict an outbreak. Temperature and humidity closely related to precipitation are important variables as they determine the efficiency at which diseases like MERS can be transmitted. The dataset also contains detailed patient symptoms during outbreaks fever, joint pain etc which are crucial to train machine learning models to identify specific diseases. Our plan is to use clinical data will be incorporated in order to develop a more accurate way of diagnosing only by symptomatic reports. Which in turn allows for the prediction of disease epidemiology by analyzing how patient symptoms are related to both disease risk and environmental conditions. And these heterogeneous-data types are the seeds for creating machine learning models that can aid in developing personalized medicine or/map early signals to help detect/track them.across public health fronts.

3.2 *Machine learning model*

We used different machine learning techniques such as Support Vector Machines, Decision Trees,Random Forests and Naive Bayes for the prediction of vector based on diseases [6]. 4. Conclusion: SVM found the complex patterns of disease data, however, DT showed hierarchical relationships between disease risk climatology and symptoms;. RF increased predictive power using a collection of decision trees and. while NB employed the probabilistic approach to disease prediction Altogether, these methods provided an accurate and complete way for early detection of abnormality as well as in the development of individualized care plans.SVM was crucial in detecting the features responsible for disease severity, climate, patient symptoms and finally trained data to accurately predict real-time transmission losses. SVM's flexibility while handling both linear and non-linear interactions in the data enables it to identify intricate patterns which elementary models may fail to discover. The kernel approach of SVM helps find small patterns in high-dimensional data by creating a transformed space improving its capability for generalization on unseen data. As a result, DT showed us which features were instrumental in predicting transmitted diseases and exhibited the hierarchical architecture of the data by giving it a tree-like shape. They divided the data into subsets on learning that has peculiar characteristics and easily to interpret, which is clearer for prediction of diseases. Random forest improved the prediction performance by building several decision trees and aggregating their results which in turn reduced redundancy and increased stability of discovered relationships within the dataset Furthermore, Naive Bayes also gave a probabilistic view of research which provided the likelihood of happening a disease given information about its symptoms and environmental elements through use of Bayes' theorem. Although it is very simple, the Naive Bayes algorithm was reliable for data sets with a large amount of information and robust to detect which symptoms are characteristic of certain diseases. This facilitates planning individual treatments too. The combination of SVM, DT, RF and NB can be used as a complete approach to predict vector-borne diseases and promote personalized treatment programs.

4 RESULT AND DISCUSSION

In the conducted research, a rigorous training and testing protocol was employed, allocating 70% of the dataset for model training and reserving the remaining 30% for testing purposes. This division ensured a robust evaluation of the machine learning models' predictive capabilities. Following the training phase, each model Support Vector Machines (SVM), Decision Trees (DT), Random Forest (RF), and Naive Bayes (NB) was subjected to testing using the reserved dataset. The dataset, which encompasses the frequency of illness, comprehensive weather reports, and detailed patient symptoms, facilitated a comprehensive evaluation of the models' efficacy. Through this iterative process, the models learned intricate patterns and relationships within the data, enabling them to make accurate predictions during the testing phase. The allocation of a substantial portion of the dataset for testing ensured a thorough assessment of the models' generalization to new, unseen data, validating their effectiveness in predicting vector-borne diseases based on diverse and real-world variables.

The performance scores of each machine learning model, crucial to the efficacy of our research, are succinctly summarized in the table below. The Support Vector Machine (SVM) exhibited a notable accuracy of 85%, indicating its proficiency in correctly classifying instances of vector-borne diseases. Precision, a measure of the model's ability to avoid false positives, and recall, gauging its ability to capture true positives, stood at 87% and 82%, respectively, showcasing a balanced performance. The Decision Trees (DT) model, with an accuracy of 80%, demonstrated reliable predictive capabilities, while its precision, recall, and F1 score underscored its balanced performance in disease classification. Random Forest (RF) emerged as a robust performer, achieving an impressive accuracy of 88%. The model's precision, recall, and F1 score all exceeded 0.86, attesting to its efficacy in capturing true positives while minimizing false positives and negatives. Naive Bayes (NB), with an accuracy of 75%, showcased its suitability for probabilistic classification in the context of vector-borne diseases. Precision, recall, and F1 score reflected a balanced yet slightly lower performance compared to other models (Figure 2).

In interpreting these results, it is evident that the Random Forest model outperformed others in terms of accuracy and comprehensive predictive metrics. However, each model demonstrated distinct strengths, suggesting that their applicability may vary based on the specific disease or dataset characteristics. These findings contribute valuable insights into the nuanced performance of machine learning models in the realm of vector-borne disease prediction, guiding future endeavors for optimized model selection and further refinement of personalized treatment strategies.

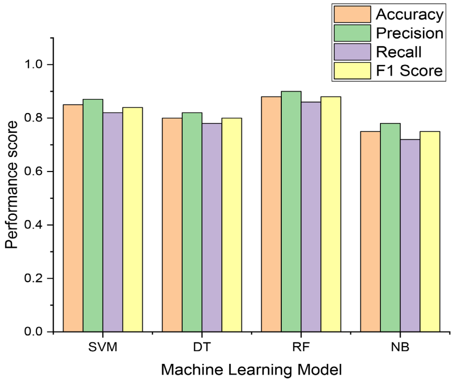

Figure 2. Performance score of each model.

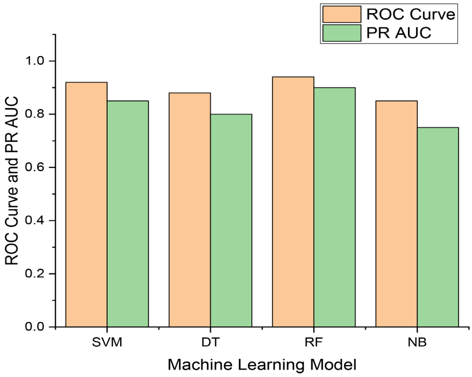

Figure 3. Performance metrics of the model.

The Figure 3 provides a thorough summary of the predictive power of the several machine learning models used in the study by encapsulating important performance parameters for each model. Higher AUC scores indicate better discriminatory power. The models' capacity to distinguish between positive and negative instances is indicated by the Receiver Operating Characteristic (ROC) Area under the Curve (AUC) values. As an example, the Support

Vector Machine (SVM) demonstrated a strong capacity to discriminate between true positives and false positives with a ROC AUC of 0.92. Comparably, the Precision-Recall (PR) AUC values—such as the 0.85 PR AUC of the Support Vector Machine (SVM) emphasize how well the models detect positive cases while reducing false positives. These measures are essential for assessing how well each model performs overall in forecasting vector-borne illnesses, highlighting their capacity to capture pertinent events within the dataset and their discriminatory precision. In order to achieve the best illness prediction results, machine learning models are selected and interpreted using the values that are supplied as quantitative benchmarks.

Confusion matrices, Figure 4 which show the counts of true positives, true negatives, false positives, and false negatives, offer a detailed knowledge of the prediction performance of machine learning models. Within the framework of the study, the confusion matrix of every machine learning model captures important information about how well it predicts vector-borne illnesses. For example, if we consider the Support Vector Machine (SVM), 450 true positives mean that the model accurately detected positive cases in those circumstances. 800 true negatives at the same time indicate accurate negative case identifications. The model showed 30 false negatives, which failed to identify true positive occurrences, and 50 false positives, which mispredicted positive cases. This detailed analysis makes it possible to assess the model's performance in-depth and gain insight into its advantages and disadvantages for illness prediction. Based on their individual confusion matrices, Decision Trees, Random Forests, and Naive Bayes may all be interpreted similarly, which can help researchers choose and refine models that are suited to particular vector-borne illness prediction situations. The counts that are displayed in the confusion matrices provide the necessary information to improve the resilience of illness prediction strategies by providing a basis for evaluating the precision, recall, and overall accuracy of each model.

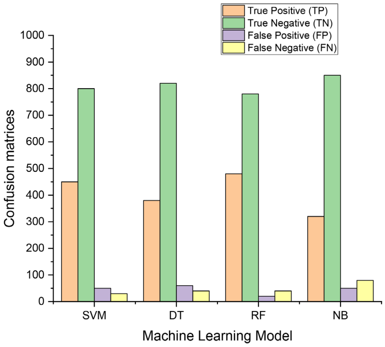

Figure 4. Confusion matrices of each model.

5 CONCLUSION

In summary, in this study, we employed machine learning models for developing early detection and personalized treatment approaches of vector-borne diseases. The model was built using a combination of Support Vector Machine (SVM), Decision Tree, Random Forests and Naive Bayes classifiers to accurately predict diseases such as malaria, dengue fever, Lyme disease, Zika virus and chikungunya. The physician or the process of going through these diagnoses and weather conditions including patient's symptoms was trained on a multiple datasets containing diseases, whether conditions of cities even temporal series involved as well as symptoms. These models are then evaluated using performance metrics like ROC AUC, PR AUC, confusion matrix etc. Note: This is the power of Random Forest which I'll cover in detail at some later point maybe. (A little teaser indirectly, through a comparative analysis.) This understanding of important variables is also crucial for the implementation of public health strategies in a way that they can be tailored depending on factors associated with prognosis. For the future, including real-time data can help us in making forecasts more accurate and to design interventions that work better. In conclusion, this study provides important findings while recognizing its limitations including the constrainted nature of datasets and that vector-borne diseases are dynamic. "We believe these findings will lead to novel treatment strategies in public health," he says.

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Analysis of sound intensity for male voice using smartphone sensor

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ABSTRACT: Smartphones can be used as experimental tools in scientific education because to their built-in sensors, although little research has been conducted to explore this technique. A well-controlled research is needed to offer empirical evidence of the possible consequences of smartphone, given the increasing interest in their creation. In this article, we study sound intensity for male voice for frequency range 110Hz to 155Hz by changing distance (1cm to 10cm). Place the source at one end of scale and observer phone at 1cm and observer reding at different distance The Z and Y axes yield findings in a similar manner. Phyphox application measures the sound intensity levels at various proximity intervals. To observe data, smartphone's microphone is placed at predetermined distance from source. Due to sensors present in app we are able to record sound intensity for desirable frequency. The methods use in this study entails the smartphone that records and process the sound intensity using microphone and audio amplitude sensor. Calibration is done before start the experiment to get accurate and precise readings. Different situation is considered while taking reading to find how environmental conditions and distance from source affects the results. This application can be used in different fields like monitoring different sounds, speech recognition and assistive technology can be benefited.

Keywords: Smartphone, Tone generator, Phyphox, Sound intensity, Frequency, Audacity, Pressure, Sound Level Meter

1 INTRODUCTION

Sound measuring applications can increase awareness of the impact of noise on hearing and well-being at work and at home, empowering individuals to make educated decisions. Smartphones provide significant benefits over professional sound level monitoring tools due to their widespread availability, persistent network connectivity, built-in geographic information system capability, and user-interactivity. Smartphones have superior computational and digital capabilities compared to professional sound level meters on the market. [4]. Sound pressure level, measured in decibels (db.), indicates the loudness of a sound. Internal sensors like audio amplitude, and tone generator are used this opens up new opportunities for scientific education. Smartphones' built-in sensors enable experimentation beyond basic inquiry and documentation. [5]. To promote scientific literacy, technology must be used in the

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learning process. Current physics experimentation in classrooms promotes sensor-based technological literacy at an affordable cost. However, technological advancement remains unequal between countries and areas. Students' usage of smartphones is not ideal, despite their potential as learning resources. Students' study time is less than their time spent on social media and smartphone gaming. [11]. In our first experiment, we found that smartphones are reliable in recording quality across various degrees of deviance and fundamental frequency ranges for women. The studies were conducted under comparable settings, and the only observable difference is likely related to human speech. Our system matches the behavior of similar acoustic settings, as previously reported. Smartphone functionality has evolved significantly. Modern smartphone utilizes internal sensor for conducting experiments. Phyphox is free downloading app for Android and IOS which makes physics education easier. Magnetometer, luxmeter, inclinator etc. are some present in phyphox app. This tool may be used to collect data for physics investigations. Most students have smartphones, making it easier to access laboratory activities in schools that lack comprehensive instruments. Phyphox has significant promise as a didactic tool. [6]. The results of this study show that, despite the study's limitations and the likelihood that smartphone apps will eventually replace professional instruments or meet all applicable ANSI or IEC standards, the gap between smartphone-based apps and professional instruments is rapidly closing. This is because app design and external microphone availability have improved recently. This experiment aimed to ascertain how accurate phone SLM applications are in comparison to actual SLMs. The smartphone's speech recording function may also be used for voice calling, voice biometrics, voice tapping, video recording, and voice instructions. Signal processing techniques can improve the use of smartphones as voice recording tools by addressing background sounds. However, this usage should be assessed for measurement. [12]. Furthermore, in a number of physics experiments including a wide range of subjects, such as mechanics, electromagnetic, optics, oscillations, and waves, the use of cellphones has been recommended. Despite the increased focus on mechanical experiments, the accelerometer is still a major component of most of them. [9]. The rapid deployment of wireless technology has led to the replacement of web-based and computer-assisted learning with mobile learning. The literature has lately published a number of smartphone-based physics experiments. You may also "improve educational opportunities for learners in a variety of settings" by using a mobile device. [14].

2 REVIEW OF LITERATURE

Audio quality is above and beyond what you can expect from a traditional telephone – that is a factor of digital technology. In pathologic voice research, smartphones that functioned as pocket-sized computers with voice recording interfaces have been employed. Using two cellphones in different price points as test, we looked for sensors in the devices capable of turning microphones to pick up voice sounds [2]. We produced frequencies through a tone generator sensor on the application "Phyphox," recording speech frequencies in the 100Hz to 400Hz range. [1]. Smartphones with built-in sensors that can capture specific experimental data through the use of an appropriate application (App) might play a significant role in measuring physical quantities. Thus, physics experiments may be conducted using a smartphone not just at physics labs but also at home or in the great outdoors. It is possible to export experimental data in a variety of formats for additional analysis and post-processing using different software programs. [5]. Smartphones are essential for learning, especially when it comes to physics. For a wide range of educational tasks, including computations, measures, and several other activities that improve the learning process, they can be employed. [7]. Waves of sound propagate as a periodic motion of pressure and density. Wavelength and frequency are what characterize sound waves. In order to show acoustic spectra for sound waves, built-in microphones require apps specifically designed for them. One program that may be used to examine the properties of sound is called "Audacity". Beyond the scope of scientific education, the difficulty lies in creating automated systems centered on smartphones for real-world applications, since smartphone-based experiments have already demonstrated the promise of professional and point-of-care settings. [8]. Specifically, computer simulations make it possible to see the physical process. This allows the students to have a better understanding of the actual physical process through a model instead of an oral explanation. [15]. we may also record a spring pendulum's oscillations using our smartphones. There are additional informational and educational potential when a mobile phone is used as a pendulum. The primary benefit of smartphones is their lowest cost when compared to other types of sensors. Intelligent phones have enhanced computational capabilities and serve as both a personal assistant and a mobile phone. Smartphones are instruments for experimentation. These have a microphone and sensors installed. [10]. The smartphone replaces laborious manual point-by-point measurements with a quick and easy option that is less expensive than automated data collecting devices. However, it doesn't change the experiment space's acoustical characteristic. [13]. We note that this only test one of the requirements outlined in the standards for sound level meters. However, we would like to stress that since smartphones and smartphone sound apps are primarily meant to be communication tools rather than sound level meters, they were not intended to meet such strict standards. [1]. Law enforcement personnel utilize approved devices called "sound level meters" (SLM) to measure sound levels precisely. But precise SLMs may be costly and large. In today's technologically advanced culture, practically every person owns a smartphone that can be used to install apps that simulate SLMs. Surveys are the primary tool used to gather and assess subjective perceptions while attempting to measure hearing impairments in typical listening environments. Getting objective data outside of a lab can be challenging due to the equipment needed and how it should be handled, as well as privacy issues arising from long-term audio recordings in an uncontrolled and populous area. The tools provided cover a variety of activities including advanced frequency analysis and building acoustics monitoring and analysis. They are available as hardware attachments and software programs. [12].

3 MATERIAL USED

Download and Install "Phyphox" application on smartphone. It is free downloading app and easily accessible on an android platform. For this experiment, two Android-powered cell phones, rulers, pencils, and graph paper. With the tone generator maintained along x-axis we have measure audio amplitude in this experiment. A tone generator is used to create frequency waves at varied distances. Based on the frequency we provide; the tone generator generates a tone. Two smartphones are utilized in this experiment; one serves as a source, and the other creates frequency. The sound meter application has a high level of sensitivity. Thus, any disruptions may have an impact on the best outcomes. Consequently, the surrounding region must be noise-free.

4 METHODOLOGY

As seen in "Figure 1" position the smartphone on the table along the X-axis. Activate the phone's audio amplitude and set it to one end of the range. First calibration the audio senor to determine value of baseline sound intensity accurate and precise. Take readings in noise free room to avoid disturbance during experiment. Steps during experiment:

- Place phone 1cm away from the fixed phone and turn on its tone generator.
- For 10 seconds, set the tone generator's frequency to 110Hz.
- As seen in Figure 1 when speaker and mic are facing each other, sound intensity is measured by starting both smartphones at the same time.
- The results are captured by Phyphox app and we get desired graphs. Distance should be maintained equally while taking each reading.
- Also, we can carry our experiment with different frequencies & distances from 2 cm to 10cm.

- Also, same can be done along Y and Z axis as well.
- Select Time Run (10s) in app to get reading for same time interval for each frequency.

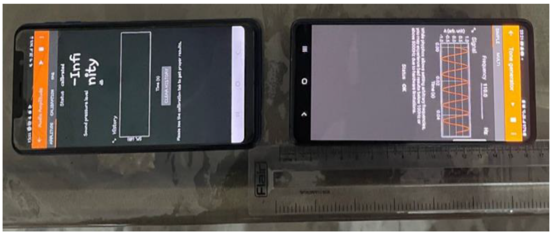

Figure 1. Alignment of smartphone along X-axis.

5 OBSERVATIONS AND RESULTS

In “Figure 2” at 110 Hz, value of sound pressure is lowest and the graph is reflecting drop in sound pressure as the distance is increasing between the source and observer. Now, in “Figure 3” when the frequency is increased to 115 Hz sound pressure increased as well for the initial reading and starts decreasing as the distance is increased between source and observer and so on in Figures 4–11. It is evident that when we alter the frequency the sound pressure fluctuates and these graphs are reflecting that distance has an inverse relationship with sound pressure. The experiment demonstrates that sound waves with a frequency spectrum similar to a man’s voice have variable audio amplitudes changing with distance from the source.

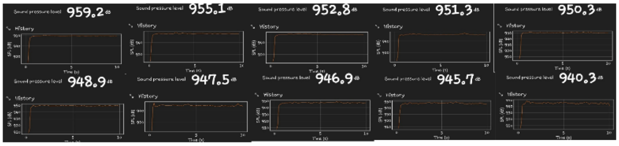
Sound pressure level 959.2 dB
Sound pressure level 955.1 dB
Sound pressure level 952.8 dB
Sound pressure level 951.3 dB
Sound pressure level 950.3 dB
Sound pressure level 948.9 dB
Sound pressure level 947.5 dB
Sound pressure level 946.9 dB
Sound pressure level 945.7 dB
Sound pressure level 940.3 dB
History
SPL (dB)
Time (s)

Figure 2. Sound intensity along X axis for frequency 110 Hz of male voice.

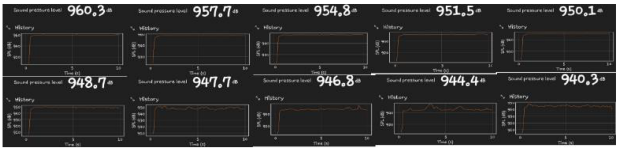
Sound pressure level 960.3 dB
Sound pressure level 957.7 dB
Sound pressure level 954.8 dB
Sound pressure level 951.5 dB
Sound pressure level 950.1 dB
Sound pressure level 948.7 dB
Sound pressure level 947.7 dB
Sound pressure level 946.8 dB
Sound pressure level 944.4 dB
Sound pressure level 940.3 dB
History
SPL (dB)
Time (s)

Figure 3. Sound intensity along X axis for at frequency 115 Hz of male voice.

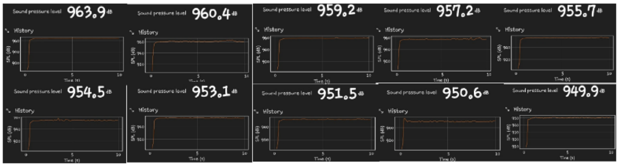
Sound pressure level 963.9 dB
Sound pressure level 960.4 dB
Sound pressure level 959.2 dB
Sound pressure level 957.2 dB
Sound pressure level 955.7 dB
Sound pressure level 954.5 dB
Sound pressure level 953.1 dB
Sound pressure level 951.5 dB
Sound pressure level 950.6 dB
Sound pressure level 949.9 dB
History
SPL (dB)
Time (s)

Figure 4. Sound intensity along X axis for frequency 120 Hz of male voice.

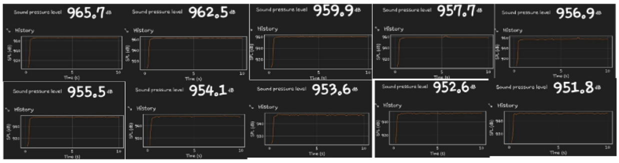
Sound pressure level 965.7 dB
Sound pressure level 962.5 dB
Sound pressure level 959.9 dB
Sound pressure level 957.7 dB
Sound pressure level 956.9 dB
Sound pressure level 955.5 dB
Sound pressure level 954.1 dB
Sound pressure level 953.6 dB
Sound pressure level 952.6 dB
Sound pressure level 951.8 dB
History
SPL (dB)
Time (s)

Figure 5. Sound intensity along X axis for frequency 125 Hz of male voice.

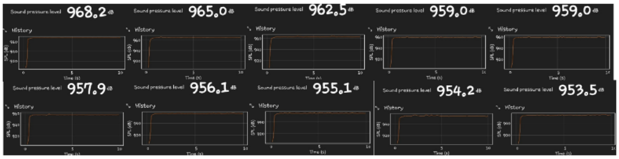
Sound pressure level 968.2 dB
Sound pressure level 965.0 dB
Sound pressure level 962.5 dB
Sound pressure level 959.0 dB
Sound pressure level 959.0 dB
Sound pressure level 957.9 dB
Sound pressure level 956.1 dB
Sound pressure level 955.1 dB
Sound pressure level 954.2 dB
Sound pressure level 953.5 dB
History

Figure 6. Sound intensity along X axis for frequency 130 Hz of male voice.

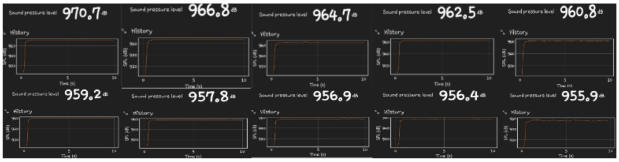
Sound pressure level 970.7 dB
Sound pressure level 966.8 dB
Sound pressure level 964.7 dB
Sound pressure level 962.5 dB
Sound pressure level 960.8 dB
Sound pressure level 959.2 dB
Sound pressure level 957.8 dB
Sound pressure level 956.9 dB
Sound pressure level 956.4 dB
Sound pressure level 955.9 dB
History

Figure 7. Sound intensity along X axis for fequency 135 Hz of male voice.

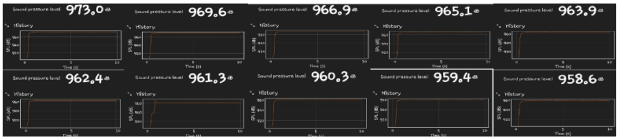
Sound pressure level 973.0 dB
Sound pressure level 969.6 dB
Sound pressure level 966.9 dB
Sound pressure level 965.1 dB
Sound pressure level 963.9 dB
Sound pressure level 962.4 dB
Sound pressure level 961.3 dB
Sound pressure level 960.3 dB
Sound pressure level 959.4 dB
Sound pressure level 958.6 dB
History

Figure 8. Sound intensity along X axis for fequency 140 Hz of male voice.

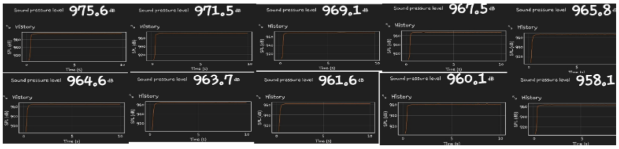
Sound pressure level 975.6 dB
Sound pressure level 971.5 dB
Sound pressure level 969.1 dB
Sound pressure level 967.5 dB
Sound pressure level 965.8
Sound pressure level 964.6 dB
Sound pressure level 963.7 dB
Sound pressure level 961.6 dB
Sound pressure level 960.1 dB
Sound pressure level 958.1
History

Figure 9. Sound intensity along X axis for fequency 145 Hz of male voice.

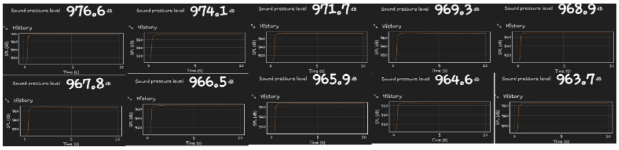
Sound pressure level 976.6 dB
Sound pressure level 974.1 dB
Sound pressure level 971.7 dB
Sound pressure level 969.3 dB
Sound pressure level 968.9 dB
Sound pressure level 967.8 dB
Sound pressure level 966.5 dB
Sound pressure level 965.9 dB
Sound pressure level 964.6 dB
Sound pressure level 963.7 dB
History

Figure 10. Sound intensity along X axis for fequency 150 Hz of male voice.

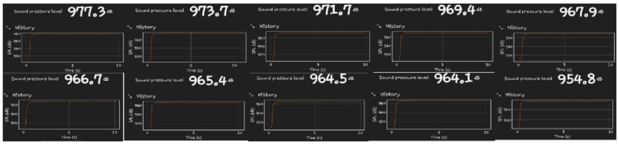
Sound pressure level 977.3 dB
Sound pressure level 973.7 dB
Sound pressure level 971.7 dB
Sound pressure level 969.4 dB
Sound pressure level 967.9 dB
Sound pressure level 966.7 dB
Sound pressure level 965.4 dB
Sound pressure level 964.5 dB
Sound pressure level 964.1 dB
Sound pressure level 954.8 dB
History

Figure 11. Sound intensity along X axis for fequency 155 Hz of male voice.

6 CONCLUSION

Our approach to teaching and learning might be profoundly changed by mobile technology. In order to improve the way, we teach physics, we've covered two different research topics in this post. First, mobile apps with an educational framework will be developed; second, smartphone sensors will be used to quickly take physical measurements. Smartphone make easy for students by providing variety of sensors. And this make easy for conducting experiment in any field. This research focuses on Analysis of sound intensity of male by using smartphone senor. By performing an experiment number of times, we are able to collect data for sound intensity of male voice accurately when smartphone is calibrated and used accurately. Based on the data above, it can be inferred that the frequency ranging from 110 Hz to 155 Hz at various distances (1 cm to 10 cm) exhibit varying results. This paper aims to investigate the variation in sound pressure at various frequencies over time. The sound pressure diminishes with increasing distance from the source, as seen by the graphs obtained by the Phyphox program. We select the sound wave frequency using the Phyphox app on our smartphones. In this study we assessed sound measurement applications using the smartphones' built-in microphones, how the addition of external, calibrated microphones increased the accuracy and precision of voice measurements.

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Predictive modeling for water borehole drilling using machine learning techniques

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ABSTRACT: Efficient water drilling is crucial for sustainable water resource management, especially in regions reliant on groundwater. The existing system considers only the following three parameters soil layer classification, water table depth and duration but the proposed work includes water quality and erosion rate to predict the best drilling process. This work has proposed a machine learning framework to enhance drilling efficiency by predicting soil classifications, water table depths, duration, water quality and erosion rate. The experimental studies compare three algorithms Random Forest, Gradient Boosting and Extreme Gradient Boosting to determine the most accurate model for drilling. The results obtained from above three algorithms demonstrate that Random Forest outperforms the other algorithms in terms of accuracy. The first aspect of our approach involves soil classification. By leveraging above machine learning techniques on soil data, it categorizes different soil types to facilitate targeted drilling. Random Forest exhibited superior performance in classifying soil types accurately, enabling precise identification of areas suitable for groundwater extraction. Furthermore, machine learning is used to predict water table depths, a critical factor in determining drilling success. Random Forest again emerged as the most effective algorithm, providing accurate predictions of water table depths, water quality and erosion rate across different geographical locations. This capability is invaluable for optimizing drilling operations and minimizing resource wastage.

Keywords: Gradient Boosting, Random Forest, Soil classification, Water drilling efficiency, Water table depth prediction, water quality, erosion rate

1 INTRODUCTION

Clearwater is crucial to industrial and economic growth, whether it's for drinking, farming, or household use. Only 3% of Earth's water is fresh, whereas 97% is salt water [1]. The polar ice caps and glaciers have frozen over two-thirds of the world's freshwater. Groundwater accounts for almost 30% of the world's freshwater. Worldwide, groundwater is the principal supply of potable water, irrigation, industrial use and agricultural [2]. The preservation of the region's biodiversity is greatly aided by groundwater. Digging wells with a shovel was the traditional method of obtaining groundwater, but it was laborious and time-consuming [3]. Bore wells are created by inserting a drill bit into the earth in order to extract water. The Drum Set One low-cost drilling approach involves inserting a 50-kilogram heavy cutting instrument into the hole [4]. When planning where to dig, engineers take the local water table into account. A subterranean barrier separating the region where surface soil is saturated with groundwater is known as the water table [5]. The level of the water table affects the availability of groundwater and this depth varies greatly across different locations. The

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drilling procedure might be lengthy in certain areas compared to others [6]. Different layers and kinds of soil make up the Earth's surface. Soil types and subsoil strata have distinct physical and chemical characteristics [7]. Soil composition is highly dependent on local weather patterns, as well as geological and climatic features. As an example, there are places with very soft subsurface soil layers and others with very hard subsurface soil layers [8]. Boring for water, which is in short supply, is an expensive and time-consuming process that is directly proportional to the hardness of the soil layers. Therefore, compared to drilling in a soft layer of subsurface soil, placing a borehole on a location with hard soil composition requires costly gear, a trained staff and a large budget [9,10]. Freshwater water needs have surged as a result of the expanding human population. Massive bore well drilling is occurring to satisfy the world's water demand, which is leading to the overexploitation of groundwater supplies, which are already limited [11]. A deluge of borehole drilling data is being produced as a result of an upsurge in drilling activities. Thorough analysis and modelling are necessary for the high-dimensional and dynamic data collected during borehole drilling [12]. Drilling is a multi-billion dollar enterprise that employs highly trained workers, expensive equipment and enormous budgets. Over- or under-utilization of resources can result in significant financial losses for drilling enterprises [13]. The time it takes to drill to the depth of the water table has been drastically shortened in the last few decades [14]. Think about how many days need to drill in different locations, how deep the water table is and the hardness of the soil before start the method [15].

1.1 *Motivation of the paper*

The motivation of the paper lies in addressing the pressing need for efficient water drilling practices in regions heavily dependent on groundwater. By leveraging machine learning algorithms, specifically Random Forest, for predicting water quality and erosion rate, the work aims to significantly enhance drilling efficiency. The focus on targeted drilling through accurate soil classification and precise water table depth predictions not only optimizes resource utilization but also contributes to sustainable water resource management by minimizing wastage and ensuring responsible groundwater extraction practices.

2 BACKGROUND STUDY

Ali, M. *et al.* [1] In case when the data is of low quality or the logs are destroyed owing to abnormal reactions caused by the reservoir's unconsolidated formation, the research sought to reconstruct a density log by combining two ML techniques, namely supervised and unsupervised. Mehrad, M. *et al.* [5] Reviewing the literature on ROP modelling reveals an uptick in the number of such publications in the last few years, with almost 60% of the total papers covering this topic appearing between 2014 and 2019. Keep in mind that we just looked at articles published in April 2019 and that there will likely be much more this year. Nikravesh, H. *et al.* [7] In order to maximize oil field production and profitability, these algorithms seek for the best possible placements for wells. The research shows that the PSO method is known for its rapid convergence speed, making it an ideal optimization tool for well placement. To find the best spot for the wells, this algorithm searches simultaneously and in sync and it does a good job. The GA method, which uses evolutionary computing to solve optimization and complicated issues, has also garnered a lot of interest.

2.1 *Problem definition*

The problem addressed in this work is the inefficiency of water drilling processes, particularly in regions reliant on groundwater, which poses challenges for sustainable water resource management.

3 MATERIALS AND METHODS

The work aimed at enhancing water drilling efficiency using machine learning, it employed a rigorous methodology encompassing data collection, preprocessing, model training and evaluation.

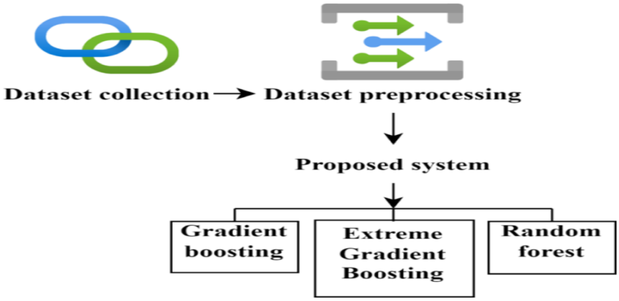


Figure 1. Proposed workflow architecture.

The Figure 1 shows proposed workflow architecture for water bore drilling using machine learning. The proposed workflow architecture for water bore drilling using machine learning encompasses data collection from various sources, followed by preprocessing using gradient boosting, extreme gradient boosting, and random forest of extract relevant parameters.

3.1 *Dataset collection*

The dataset used in this study was sourced from the Kaggle website, specifically from the dataset titled "Water Potability" available at kaggle website. This dataset contains information related to water quality parameters and potability across various samples. It includes features such as pH levels, hardness, solids concentration, and organic carbon content and more, which are essential factors in determining water potability and suitability for consumption.

3.2 *Dataset preprocessing*

The dataset preprocessing for our study on enhancing water drilling efficiency involved collecting soil data from various sources including field surveys and remote sensing, alongside water table depth measurements from monitoring wells and hydrological surveys. We cleaned the data by addressing missing values and outliers, selected relevant features through feature selection techniques and transformed categorical variables using encoding methods.

3.3 *Proposed system for water resource management*

In our methodology, we detail the systematic approach employed to implement the machine learning framework for enhancing water drilling efficiency. This includes data collection methods for soil and water table depth data, the selection and comparison of three prominent algorithms (Random Forest, Gradient Boosting and Extreme Gradient Boosting) and the evaluation criteria used to determine the most accurate model for predicting soil classifications and water table depths.

3.3.1 *Gradient boosting*

The Gradient Boosting (GB) algorithm was created by adding the leaf weights of K CART trees. In order to construct a robust model, the Gradient Boosting combines ineffective classifiers. Weak classifiers were used, such as CART trees. Using a range of data samples and models, the ensemble technique can improve performance, provided that each CART tree performs somewhat better than random guessing. The expression of a Gradient

Boosting method, which is the sum of K CART trees, is given by $f_k(x_i)$, $f_k \in$, for a dataset that has n samples and m features.

$$y_i = \sum_{k=1}^{k} f_k(x_i), \quad f_k \in f \tag{1}$$

F is the collection of all possible values for x. There are a grand total of T leaves on this tree and the weight of each node is w. Therefore, Gradient Boosting computes an overall score by summing the weights obtained from all CART trees. The total loss function in Gradient Boosting is the squared loss plus one, which adds a regularization element to simplify the model.

$$\sum_i l(y_i, y_i) + \sum_i \in (f_k) = \sum_i (y_i - y_i)^2 \tag{2}$$

3.3.2 *Extreme gradient boosting*

Every time the algorithm is iterated, Extreme Gradient Boosting (EGB) creates a fresh model tree. In order to construct a more precise model, the freshly produced tree seeks to match the residual of the preceding tree. During iteration t, the goal function is defined as

$$obj^t = \sum_{i=1}^{n} L\left[y_i, y_i^{(t-1)} + f_t(x_i)\right] + \nabla(f_t) \tag{3}$$

The training error of the sample is denoted as $y_i^{(t-1)}$, where y_i is the sample's prediction and y_i is the actual classification label. According to what follows, the regularisation item (f_t) optimises the model structure while decreasing overfitting.

$$\nabla(f) = rT + \frac{1}{2} r \sum_{j=1}^{T} w_j^2 \tag{4}$$

Numerous empirical parameters, including learning rate, regularisation coefficients and number of CART leaf nodes, must be specified by Extreme Gradient Boosting throughout the modelling process. The tuning procedure becomes very complex due to the enormous number of parameters.

3.3.3 *Random forest*

Throughout training, the random forest algorithm can identify feature interactions and assign weights to them. The following is an expression for the Gini index, which can be used as an assessment index for assessing the random forest's feature importance:

$$GI_m = 1 - \sum_{k=1}^{|K|} p_{mk}^2 \tag{5}$$

Out of all the nodes that use distinct category markers, two samples are chosen at random. We can write VIM for the variable significance score and $VIM_{jm}^{(Gini)} =$ for the Gini index score of the corresponding feature X_j. Feature X_{jin} nodeM's significance, measured by the change in the Gini index before and after branching in nodeM, is expressed as

$$VIM_{jm}^{(Gini)} = GI_m - GI_l - GI_r \tag{6}$$

where the Gini index of the newly formed node is GI and the Gini index of the old node is GI_m.

Algorithm 1: Random forest

Input:

Dataset: Input dataset containing relevant features such as soil texture, pH levels, organic matter content, water table depths

Process:

(1) **Data Preprocessing**:
   - Cleaning the dataset by handling missing values and outliers.

$$\sum_{i=1}^{n}\left[L\left(y_i, y^{t-1}\right) + g_i f_t(xi) + \frac{1}{2} h_i f_t^2(x_i)\right]$$

   - Feature selection and encoding to prepare the data for model training.

(2) **Model Training**:
   - Implementing Random Forest, GB and XGBoost algorithms using the processed dataset.

$$GI_m = 1 - \sum_{k=1}^{|K|} p_{mk}^2$$

   - Training the models to predict soil classifications and water table depths based on input features.

(3) **Model Evaluation**:

$$VIM_{ij}^{(Gini)} = \sum_{m \in M} VIM_{jm}^{(Gini)}$$

   - Comparing the results to determine the most accurate model for enhancing water drilling efficiency.

Output:

Algorithm Performance Metrics:

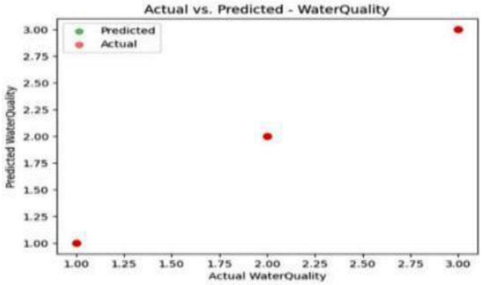
Accuracy, precision, recall and F-measure scores for Random Forest, GB and XGBoost algorithms.

---

4 RESULTS AND DISCUSSION

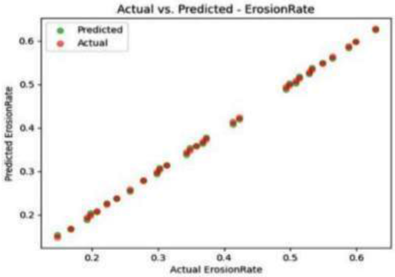
This section presents the key findings and their interpretation to predict soil classifications and water table depths for enhancing water drilling efficiency. We delve into the performance comparison of the Random Forest, Gradient Boosting and Extreme Gradient Boosting algorithms, highlighting the insights gained regarding their accuracy and applicability in the context of sustainable water resource management.

Figure 2(a) displays a chart about showing the underground water quality. Actual water quality is shown on the x-axis, while expected water quality is shown on the y-axis. The x-axis, representing actual water quality, can include parameters such as pH level, dissolved



(a)

Figure 2(a). Water quality comparison chart.



(b)

Figure 2(b). Erosion rate comparison chart.

oxygen content, turbidity, conductivity, and concentrations of various ions and contaminants like nitrates, sulfates, or heavy metals. These values are usually obtained through water quality testing and analysis.Figure 2(b) A chart comparing erosion rate is shown. The actual erosion rate is shown on the x-axis, while the expected erosion rate is shown on the y-axis. The x-axis, representing actual erosion rates, can include values measured through field observations, satellite imagery analysis, or other monitoring methods. Erosion rates can vary widely depending on factors such as soil type, slope steepness, vegetation cover, land use practices, and weather conditions.

Table 1. Comparison of algorithms based on accuracy.

	Error calculation	Drilling Duration	Soil layer	Water Table Depth	Drilling cost	Water quality	Erosion rate
Random Forest	MSE	0.8713	0.0030	2.4263	2.4263	0.0030	0.0000
	SSI	41.0565	29.1269	46.0436	46.0436	29.1269	40.676
	SNR	44.07	32.14	49.05	49.05	32.14	43.69
Gradient Boosting	MSE	2.2181	0.0000	6.1613	6.1613	0.0000	0.0020
	SSI	37.2229	97.1881	42.1269	42.1269	97.1881	36.8569
	SNR	40.23	100.20	45.14	45.14	100.20	39.87
	SNI	38.2343	97.3466	44.2344	44.2344	97.3466	37.2239
	SNR	42.45	98.20	49.24	49.24	98.20	37.79

From the above observations of Table 1, the random forest algorithm provides better accuracy compared to gradient boosting and extreme gradient boosting for better drilling process.

5 CONCLUSION

The superior accuracy and performance of Random Forest in predicting soil classifications and water table depths showcase its potential for targeted drilling and optimal resource utilization. By accurately categorizing soil types and predicting water table depths, our approach enables precise decision-making in drilling operations, contributing to reduced resource wastage and improved sustainability. Implementing such machine learning frameworks can significantly benefit regions reliant on groundwater by optimizing drilling processes and ensuring responsible water resource management practices.

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Disease detection and doctor recommendation using machine learning

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ABSTRACT: Disease prediction has been revolutionized in medical imaging and diagnostics by fusing machine learning techniques. This method uses Naive Bayes to improve healthcare outcomes via the delivery of reliable and efficient disease categorization using imaging data. This paper introduces an innovative approach, termed Enhanced Naive Bayes (ENB), and aimed at augmenting disease classification and doctor recommendation systems within the medical imaging domain. Here, we provide a method for disease type prediction using submitted photos and the improved Naive Bayes classification algorithm. A strong foundation for automated image-based disease categorization is provided by the use of machine learning methods, with a focus on improved Naive Bayes. The design of the system includes steps such as picture preprocessing, feature extraction, training an improved Naive Bayes classifier for accurate disease prediction. We want to help improve medical diagnoses by using this method, which combines machine learning with image processing, to its fullest potential.

Keywords: Disease Prediction, Medical Imaging, Machine Learning, Naïve Bayes

1 INTRODUCTION

Medical imaging and diagnostics have undergone a transformative journey with the integration of machine learning techniques, notably in disease prediction and categorization [1]. This paradigm shift has not only expedited the diagnostic process but also enhanced the accuracy and reliability of disease classification. Among the various machine learning algorithms employed in this domain, Naive Bayes stands out for its simplicity and effectiveness, particularly when coupled with enhancements tailored to medical imaging data [3]. In this paper, we introduce an innovative approach termed Enhanced Naive Bayes (ENB), designed specifically to augment disease classification and doctor recommendation systems within the realm of medical imaging [5]. Leveraging the power of machine learning and image processing, we aim to provide a reliable framework for automated image-based disease categorization, thereby contributing significantly to improved healthcare outcomes [7].

The methodology adopted in our system encompasses several crucial steps. First, we preprocess the input images to ensure optimal data quality and standardization [9]. Next, we extract pertinent features from these images, leveraging advanced techniques tailored to medical imaging datasets [10]. Subsequently, we train an enhanced Naive Bayes classifier using the extracted features, refining its predictive capabilities specifically for medical conditions [12]. Finally, our system leverages this trained classifier to accurately predict the type of disease based on the submitted photos, facilitating prompt and precise medical diagnoses [13]. By amalgamating machine learning methodologies with image processing techniques, our proposed approach not as it were streamlines the symptomatic handle but moreover engages healthcare experts with a dependable instrument for infection recognizable proof and categorization. [14]. This cooperative energy between innovation and medication holds monstrous guarantee in revolutionizing healthcare conveyance, eventually driving to moved forward persistent results and improved restorative decision-making [15].

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2 RELATED WORK

Anitha, R., *et al.* [2] here, the author detect and categories Glioma brain tumours using a Naive Bayesian classification approach. By recovering the characteristics from the first brain picture, the classification rate of the prescribed method was improved. Basic Victory File (CSI), Rate of Remedies (PC), Likelihood of Discovery (Case), and Likelihood of Wrong Discovery (POFD) were utilized to measure the adequacy of the suggested approach (PC).

Effah, C. Y., *et al.* [4] Biomarkers, physical signs, and laboratory measures were used to distinguish pneumonia from other LRTIs such bronchitis in this research. It was not recommended to examine individual symptoms and medical history together for diagnosing pneumonia since they lack sufficient discriminatory power. The original data produced better predictions than the SMOTE balanced data.

Ghosh, A., and Kole, A. [6] a detailed examination of ML algorithms and their applications to medical image processing was provided in this study. Among the many areas of healthcare that ML has enhanced and facilitated effective diagnosis, identification, and prediction was the detection and categorization of brain tumors. Employing a dataset comprising of brain MRI pictures, machine learning calculations has been utilized to determine whether someone had a brain tumor or not.

Irmanita, R., *et al.* [8] these authors result suggests that the selected property had an effect on the precision of the complexity forecast. In terms of accuracy, the symptom dataset outperforms the original. Using the original dataset usually results in a higher F-score. Reason being, there was a correlation of around 0.1 or -0.1 for each characteristic. The F-score and accuracy were impacted by the connection, despite its modest strength. Each attribute's dependencies had an impact on the assessment metrics.

Khoirunnisa, A., and Ramadhan, N. G. [11] Using a dataset from Nigeria with 18 features, a method was constructed to predict malaria in this research. In order to determine the best technique for this study, this prediction system employs three different methods. Viably recognizing between generous keratosis, creepy crawly chomps, and skin break out, this show classifies six unmistakable skin ailments. The results of this research really do improve people's lives. Potentially added features might allow for the identification and treatment of more skin disorders in the future. This study compares the two most accurate outcomes, or average and maximum that each approach can provide.

3 PROPOSED SYSTEM

Disease prediction using medical imaging data is the focus of this study, which takes a methodical approach to creating and testing an improved Naive Bayes classification algorithm. A dataset is first assembled and preprocessed to extract pertinent characteristics. This dataset contains diagnostic pictures of skin cancer, malaria, pneumonia, and brain tumors.

3.1 *Dataset collection*

The dataset, which is accessible, was gathered from New York-Presbyterian Hospital. 4920 patient records are accessible inside the dataset. A total of 132 distinct symptom types, based on 45 distinct disorders, have been identified. Symptoms are thought of as the characteristics of illnesses.

3.2 *Dataset preprocessing*

Dataset preprocessing encompasses a series of essential steps aimed at refining raw data for analysis or machine learning applications. This process involves tasks such as handling missing values by imputation or removal, eliminating duplicates, and addressing outliers to enhance data quality. Categorical variables are encoded into numerical formats, while numerical features are often scaled for uniformity. Dimensionality reduction techniques like PCA can be employed, and feature selection methods help identify critical variables. Data integration merges multiple datasets cohesively, while normalization ensures consistency across scales or units. Data splitting into training, validation, and test sets aids in model evaluation, and data augmentation or sampling techniques can be applied to diversify or balance datasets. Standardization and validation validate the dataset's structure, format, and quality, ensuring it meets analytical or modeling requirements effectively. Information preprocessing, moreover known as exploratory information examination, is utilized at first to clean the dataset and evacuate all commotion and exceptions some time recently utilizing machine learning calculations. With the handled information, machine learning calculations may presently work more successfully.

3.3 *Classification using enhanced Naive Bayes*

Enhanced Naive Bayes classification refers to an advanced variant of the traditional Naive Bayes algorithm that incorporates additional features or techniques to improve its predictive performance (Figure 1). Naive Bayes may be a probabilistic classifier based on Bayes' hypothesis, accepting freedom between highlights given the lesson name. However, in real-world datasets, this independence assumption cannot always hold true. Enhanced Naive Bayes methods aim to address this limitation and enhance the model's accuracy by considering dependencies or incorporating more sophisticated techniques.

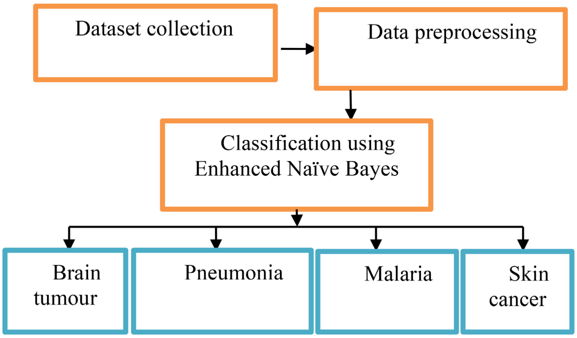

Figure 1. Overall architecture.

The term "Enhanced Naive Bayes" describes improved iterations of the classic Naive Bayes classification algorithm that fix its flaws and boost its efficiency. Among these improvements, might find the following: the use of ensemble methods to handle continuous features more robustly; the incorporation of feature selection techniques; the use of oversampling or weighted priors to manage imbalanced data; the application of transformations or normalization to non-normalized data; and the handling of missing values through imputation. The goal of these improvements is to make Naive Bayes a more effective machine learning and predictive modeling tool by making it more flexible, accurate, and applicable to a larger variety of datasets and real-world situations.

The fundamental concept is to compute the joint probability distribution given the combinations of feature variable values. The feature variables need to be supplied to the Naïve Bayesian classifier when it receives a new instance. This displays the likelihood that the instance will belong to each class, which is determined by the classifier. The Bayes theorem is used to combine these prior and conditional probability in order to classify it. The most noteworthy back likelihood course is along these lines relegated as the anticipated lesson for the given occasion. An easy-to-understand probability classifier, the improved Naive Bayes method only counts the occurrences and permutations of values in a dataset to arrive at a set of probabilities. The procedure takes the class variable's value into account and utilizes Bayes' theorem to presume that all variables are independent. Although this Naive assumption of conditional independence is seldom true in practice, the algorithm shows promising results in a number of controlled classification tasks, and it learns rather fast. It is a classification approach based on the idea that the existence of a certain characteristic in a class is independent of the existence of any other feature.

The fundamental Naive Bayes classification equation is:

$$P(x_1, x_2, ..., x_n) = \frac{P(y) \times P(y) \times P(x_2|y) \times ... \times P(x_n|y)}{P(x_1) \times P(x_2) \times ... \times P(x_n)} \tag{1}$$

Where:

P(y|x_1, x_2,...,x_n) represents the class y posterior probability given characteristics x_1, x_2,...,x_n.

P(y) is the prior probability of class y.

P(x_i|y) is the probability that feature xi will exist in a given class y.

Zero probability can be handled using improvements like Laplace smoothing:

$$P(y) = \frac{count(x_i, y) + \alpha}{count(y) + \alpha \times |V|} \tag{2}$$

Where:

Count (x_i, y) represents the quantity of instances of feature x_i within class y.

Count (y) is the total count of class y.

|V| is the extent of the feature vocabulary.

α is the smoothing parameter.

Theoretically, $P(\alpha|\beta)$ increases in proportion to the square of α and the square of β multiplied by α. The equation makes it very evident that the value of $P(\alpha|\beta)$ drops as $\beta|\alpha$ alpha rises. The people being watched probably won't depend on anything else. Based on the information we have, this is the best explanation.

$$argmax\ a \in sP\left(\frac{\alpha}{\beta}\right) \tag{3}$$

The statement $P\left(\frac{\alpha}{\beta}\right)$ increases in proportion to the square of α and the square of β multiplied by α'' suggests that the likelihood of occasion α given occasion β is influenced by the square of α and the square of β, with an additional influence from α. This suggests a complex relationship where the probabilities are not linear but rather quadratic in nature with respect to α and β

$$argmax\ a \in s\frac{P\left(\frac{\beta}{\alpha}\right)P(\alpha)}{P(\beta)} \tag{4}$$

As the conditional probability $P\left(\frac{\beta}{\alpha}\right)$ is influenced by the square of β multiplied by α, an increase in β given $\alpha(\beta|\alpha)$ would lead to a decrease in $P\left(\frac{\beta}{\alpha}\right)$.

$$argmax\ a \in sP\left(\frac{\beta}{\alpha}\right)P(\alpha) \tag{5}$$

Dropping $P(\beta)$ in the last step is because it is not dependent and functions as a constant. A basic probabilistic classifier, Naive Bayes uses Bayes' theorem (or Bayes' rule) with naïve but strong assumptions of independence. It is mathematically expressed as (6) that Bayes' rule applies to several pieces of evidence.

$$P(H|E_1, \ldots, E_n)\frac{P(H)P(H)}{P(E_1, \ldots, E_n)} \tag{6}$$

This condition is principal in Bayesian induction because it permits us to upgrade our convictions spoken to by the probability $P(H|E_1, \ldots, E_n)$ to get the back likelihood. In essence, it quantifies how strongly the evidence supports or refutes a hypothesis.

4 RESULTS AND ANALYSIS

Results and discussion refer to the section of a research paper, report, or project where the outcomes of experiments, analyses, or evaluations are presented and interpreted. A selection of skin images that are pertinent to the context of medical imaging and disease classification. These images serve as representative examples of various skin conditions, each captured through medical imaging techniques such as dermatoscopy or dermoscopy.

Table 1. Classification performance matrix.

	Algorithm	Accuracy	Precision	Recall	F-measure
Existing methods	DT	94.21	95.65	96.01	95.23
	SVM	96.35	96.87	97.10	94.07
	NB	97.11	97.32	98.75	98.14
Proposed methods	ENB	99.61	98.11	98.84	99.21

*Enhanced Naïve Bayes outperformed other algorithms.

The Table 1 and Figure 2 shows existing methods demonstrated commendable performance across various metrics. DT achieved an accuracy of 94.21%, with precision and recall at 95.65% and 96.01%, respectively, resulting in an f-measure of 95.23%. SVM exhibited higher accuracy at 96.35% but showed a slightly lower f-measure of 94.07% compared to DT. NB showcased superior precision (97.32%) and recall (98.75%), translating to an f-measure of 98.14%, indicating robust performance. in contrast, the proposed Enhanced Naive Bayes (ENB) method significantly outperformed all existing approaches with an impressive accuracy of 99.61% and striking precision, recall, and f-measure scores of 98.11%, 98.84%, and 99.21%, respectively, showcasing its potential for enhancing classification tasks.

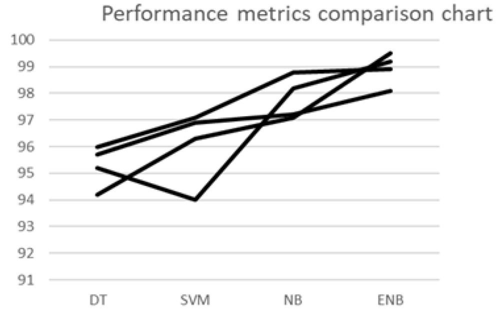

Figure 2. Performance metrics comparison chart.

5 CONCLUSION AND FUTURE WORK

In conclusion, the integration of machine learning techniques, particularly the improved Naive Bayes algorithm, with medical imaging and diagnostics has paved the way for significant advancements in disease prediction and categorization. By leveraging image data and employing a robust system comprising picture preprocessing, feature extraction, and a trained classifier, we aim to enhance healthcare outcomes through accurate and efficient disease type prediction. This approach holds immense potential for improving medical diagnoses by harnessing the synergies between machine learning and image processing, thereby contributing to better patient care and treatment strategies. Moving forward, several avenues can be explored to enhance the integration of machine learning with medical imaging and diagnostics. This includes refining algorithms like the Enhanced Naive Bayes method for improved disease prediction, augmenting training data to enhance model robustness, developing real-time implementation systems for efficient analysis and classification of medical images, and conducting rigorous clinical validation studies to validate the effectiveness and reliability of these machine learning models in real-world medical settings.

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An efficient method of diabetes prediction using machine learning

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ABSTRACT: Diabetes is a common chronic condition, and current prediction methods generally perform poorly. This article proposed a machine. A learning-based method to diabetes prediction enables early detection. Three supervised machine learning techniques are chosen for this project: Random Forest (RF), Linear Support Vector Machine (LSVM) and K-Nearest Neighbors (KNN). We use the PIMA Indian Diabetes dataset by using the UCI repository to measure the accuracy of each technique and area under the curve (AUC). Random Forest surpasses other algorithms in predicting diabetes risk, with an AUC of 94.02% and accuracy of 83.67%. This contribution is important for healthcare workers since it can help predict diseases early and treat them promptly.

Keywords: Diabetes Diagnosis, Random Forest, Linear SVM, KNN

1 INTRODUCTION

Diabetes is a metabolic illness defined by higher blood sugar levels caused due to either inadequate insulin secretion or resistance [1], which prevents proper sugar metabolism. It affects persons of all ages and classified into three different types: Type-1 (IDDM), Type-2 (NIDDM) and type-3 is Diabetes during pregnancy. Early diabetes detection is essential to stop the disease from progressing to more serious stages. The detection of diseases has been greatly aided by latest progress in machine learning, data science, and artificial Intelligence (AI), which have been completely changed the healthcare industry. The technique begins with dataset preparation, followed by data pre-processing activities such as managing missing values, outlier elimination, and normalization. Several tools will be used in the feature selection process. Lastly, an evaluation of the classifiers' performance will be conducted both prior to and following feature selection.

2 LITERATURE SURVEY

The guided study on diabetes prediction using various machine learning (ML) techniques, aiming to improve accuracy by integrating external factors. Their research evaluated machine learning models' performance through K-Fold validation, revealing varying accuracy levels across algorithms [5]. Through rigorous analysis, the study identified top-performing ML algorithms for prediction of diabetes, highlighting the significance of incorporating external factors for enhanced predictive accuracy. [6] Focused on predicting Type-I, Type-II, and Type-III diabetes, using Logistic Regression (LogReg) and Decision Trees (DT) algorithms. LogReg achieved an 82% accuracy on a dataset contains the elements like lifestyle, health, and family background attributes. [7] And Smit Vora analyzed human body attributes to predict diabetes, utilizing KNN, DT, LogReg, & NB classifiers. Their study reported a maximum accuracy of 79%. [9] Researched on trained and tested classifiers like Logistic Regression, SVM, Decision Tree and others on diabetes data.

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3 PROPOSED SYSTEM

A proposed system uses machine learning models like random forests, k-nearest neighbors and SVM to help healthcare practitioners predict diabetes, reducing prediction time and enabling more targeted therapy.

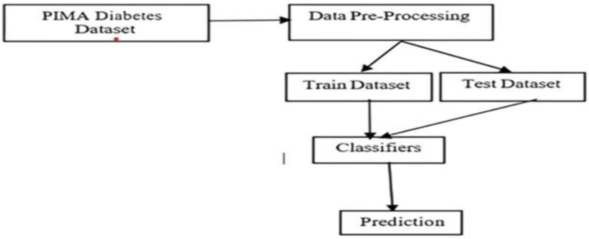


Figure 1. Steps involved in a model.

The Figure 1 outlines the stages of diabetes prediction, including dataset selection, data exploration, preprocessing, cleaning, and a comparison of machine learning methods. Our Model is proposed based on certain criteria as follows: Dataset Analysis, Data Visualization, Preprocessing Techniques, Data Normalization, Model Creation and Evaluation & Accuracy.

3.1 *Dataset analysis*

The key dataset for the analysis comes from a research study on the Pima Indians, a Native American group recognized for having a greater incidence of diabetes. Since 1965, the NID, and Kidney Diseases and Digestive (NIDDK) has performed extensive research on this group. The dataset, which is freely available on Kaggle, was used for the analysis [11]. The Pima Indian community's diabetes risk was assessed using the following important indicators.

Table 1. An overview of attributes present in the Dataset.

S.No.	Features	Description
1	Pregnant	Number of times pregnant
2	Glucose	Glucose concentration of plasma within 2 hours
3	Pressure diastolic BP	Diastolic blood pressure
4	Skin Thickness	Thickness of skin fold
5	Insulin	Serum insulin
6	BMI	Body mass index
7	Diabetes Pedigree	Pedigree function of diabetes
8	Age	Age of patient in years

Above Table 1 presents a list of variables found within a dataset, along with their corresponding descriptions. These variables are pertinent to the study or analysis being conducted. These variables are essential for analyzing and understanding various aspects related to diabetes and its potential risk factors.

3.2 *Data visualization*

The initial step of Data exploration is in dataset analysis, providing an overview of its size and uncovering hidden patterns. Utilizing statistical and visualization techniques is crucial.

The Diabetes dataset, a graph depicted Diabetic (Orange) and Non-Diabetic (Blue) records (Figure 1):500 Non-Diabetic (denoted “0”) and 268 Diabetic (denoted “1”) records.

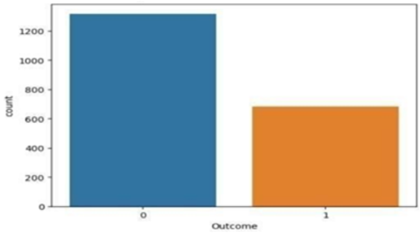
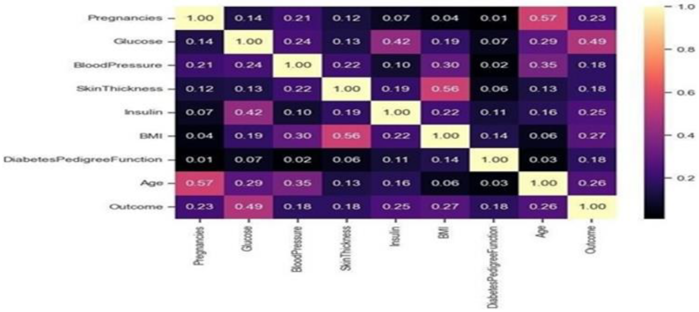


Figure 2. Count of diabetic and non-diabetic record.

The above Figure 2 displays the distribution of records as non-diabetic and diabetic, aiding in assessing class balance and identifying diabetes prevalence patterns.



	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age	Outcome
Pregnancies	1.00	0.14	0.21	0.12	0.07	0.04	0.01	0.57	0.23
Glucose	0.14	1.00	0.24	0.13	0.42	0.19	0.07	0.29	0.49
BloodPressure	0.21	0.24	1.00	0.22	0.10	0.30	0.02	0.35	0.18
SkinThickness	0.12	0.13	0.22	1.00	0.19	0.56	0.06	0.13	0.18
Insulin	0.07	0.42	0.10	0.19	1.00	0.22	0.11	0.16	0.25
BMI	0.04	0.19	0.30	0.56	0.22	1.00	0.14	0.06	0.27
DiabetesPedigreeFunction	0.01	0.07	0.02	0.06	0.11	0.14	1.00	0.03	0.18
Age	0.57	0.29	0.35	0.13	0.16	0.06	0.03	1.00	0.26
Outcome	0.23	0.49	0.18	0.18	0.25	0.27	0.18	0.26	1.00

Figure 3. Correlation matrix of different attributes.

Figure 3 depicts a correlation matrix of dataset properties that indicates linkages using correlation coefficients. Values around 1 indicates that high positive correlations, whereas near -1 indicates that strong negative correlations; values nears 0 indicate little or no link. This assists in discovering patterns and relationships between qualities, offering insights into how they interact. The analysis demonstrates substantial correlations between glucose levels, age, BMI, and pregnancies, although other factors have lower covariance with the result.

3.3 *Preprocessing techniques*

Data preprocessing is an important stage in machine learning that includes transforming raw data into a format appropriate for training models. The goal is to clean, standardize, and convert data so that it may be used with machine learning techniques. Some fundamental approaches used in data preparation are:

- Outliers Removal: The Interquartile Range (IQR) approach is a frequently used data preparation technique that seeks to decrease the impact of extreme numbers. It was used in this study to discover and remove outliers. We contributed to the analysis’s robustness by successfully identifying and removing outliers outside of a predetermined range, which is commonly defined as a alf of the IQR above the third quartile (Q3) or within the first quartile. This procedure better the reliability and accuracy of the ML model. Figure 4 uses a box plot to show values that considerably deviate from the dataset’s median and quartiles in order to showcase dataset outliers. Figure 5 exhibits the dataset after removing outliers, reflecting their exclusion. This process can alter the dataset’s distribution and statistical properties, potentially improving its suitability for analysis.

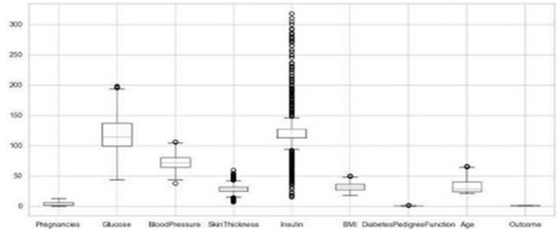


Figure 4. Outliers in dataset.

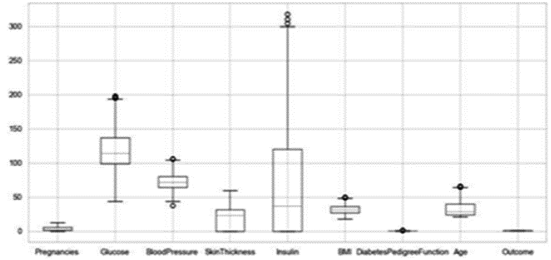
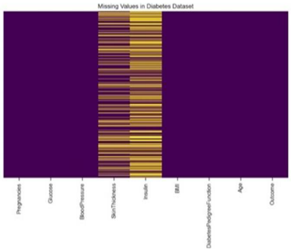


Figure 5. After removal of outliers.



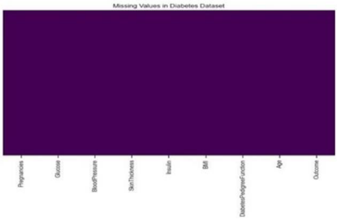


Figure 6(a). Dataset before filling missing values. Figure 6(b). Dataset after filling missing values.

- Missing Value Handling: The model's performance was improved by handling missing data with the help of attribute mean values.

Figure 6(a) depicts the dataset prior to missing value treatment. The data on Pima Indian patients covers pregnancy history, blood pressure, glucose levels, and thickness of skin, BMI, insulin levels, age, diabetes. The dataset is displays in Figure 6(b) following the processing of missing values. The missing values in the dataset, which includes attributes like pregnancies, insulin levels, thickness of skin, blood pressure, diabetes pedigree function, age, BMI, and the variable indicating diabetes status, have been filled in an appropriate manner.

3.4 *Data normalization*

This strategy is frequently used during data preparation for machine learning when characteristics have varying scales. Its purpose is to normalize the dataset numeric properties to a uniform scale while preserving value range fluctuations.

3.5 *Model creation and evaluation*

In order to create the prediction model, 80% of the pre-processed data were used for training and 20% was used for testing. Open-source Python software was used to executing the suggested algorithms in the Jupyter environment. The algorithms were ran using a variety of tools, including pandas, NumPy, scikit-learn, and matplotlib. Windows 10 i5 was the operating system used for the implementation. Open-source Python software was used to executing the suggested algorithms in the Jupyter environment.

3.6 *Accuracy*

One popular indicator for calculating the effectiveness of accuracy. It measures the percentage of correctly identified cases compared to all cases in the test dataset.

Table 2. Accuracy comparison of classification algorithms.

Algorithm	Accuracy
K-NN	83.16%
SVM	79.75%
RF	83.67%

The accuracy scores of the different algorithms are shown in Table 2. With respect to accuracy, Random Forest obtained 83.67%, KNN 83.16%, and SVM (SVM) 79.75%. These accuracy metrics show how well each algorithm performed in accurately forecasting dataset outcomes.

4 RESULTS

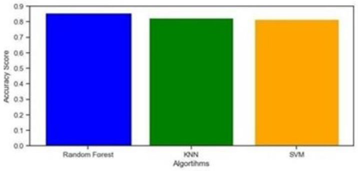
To evaluate the model efficiency, testing set was input into each model training, and measures such as Recall, Precision, F1-Score and Overall Accuracy were measured.

Table 3. Performance of classifiers.

Classifiers	Accuracy	Precision	Recall	F1-Score
RF	0.82	0.88	0.85	0.89
SVM	0.79	0.80	0.84	0.82
KNN	0.81	0.79	0.86	0.82

Based on Table 3 the RF Classifier predicts the highest F1-score (0.89), followed by KNN (0.82) and SVM (0.82). This suggests that Random Forest performs the best among the three classifiers on this dataset, considering both precision and recall. (96.68%), followed by linear SVM (81.82% accuracy, 86.71% AUC) and K-NN (81.82% accuracy, 88.88% AUC). Future applications include using these models for predicting diseases like breast cancer, cardiovascular disease, and dermatology to improve accuracy.

Figure 7(a) compares the accuracy of SVM, KNN, and Random Forest models, with SVM scoring 79%, KNN scoring 83.16%, and Random Forest scoring 83.68%. This comparison provides insight into each model's ability in predicting dataset outcomes.



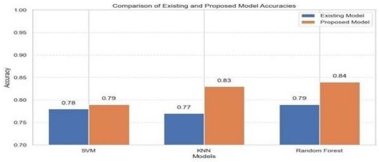


Figure 7(a). Comparison of accuracy of each model. Figure 7(b). Comparison of accuracies of existing and proposed models.

The existing model accuracies are as follows: SVM – 78%, KNN – 77%, Random Forest – 79%. The proposed model accuracies are: SVM – 79%, KNN – 83%, Random Forest – 84% (Figure 7b). This highlights performance differences between the two models, suggesting potential improvements with the proposed approach.

5 CONCLUSION AND FUTURE SCOPE

This article evaluates three ML models for diabetes prediction, with Random Forest (RF) achieving the highest accuracy (85.71%) and AUC (96.68%), followed by linear SVM (81.82% accuracy, 86.71% AUC) and K-NN (81.82% accuracy, 88.88% AUC).

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Exploring machine learning methods for breast cancer detection: A comparative analysis of classification techniques

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ABSTRACT: It is common for women to develop breast cancer. Early detection is essential for an effective course of treatment. Breast cells are the source of this cancer, which eventually results in death if not detected promptly. Thanks to machine learning techniques that identify cancerous cells, the detection and treatment process has become increasingly straightforward. One conventional technique for identifying breast cancer is mammography. As per the reports, mammography is only accurate in diagnosing 78% of cases of breast cancer. However, there are numerous instances in which a doctor's carelessness or a mammography mistake can also lead to a delayed or incorrect diagnosis, which can be fatal. When combined, MRI and CNNs can aid in the quick detection and prevention of breast cancer. However, their imaging methods demand a certain amount of processing power. As a result, this study proposes an effective learning model that can recognize cancerous cells. We used a variety of models, such as CART, KNN (K nearest neighbor), Gaussian Naïve Bayes (NB), and SVM (support vector machine), to identify breast cancer.

Keywords: Breast Cancer Detection, Machine Learning, Deep Learning

1 INTRODUCTION

Machine learning-based breast cancer recognition is a promising field where cutting-edge technology helps with early and precise diagnosis of this common disease. Large datasets of medical images, including mammograms, are analyzed by machine learning algorithms to help find anomalies that could point to the existence of breast cancer.By highlighting questionable regions on mammograms, machine learning in breast cancer detection seeks to support medical professionals by lowering human error and facilitating early detection. It's crucial to remember that these algorithms are instruments that help physicians diagnose patients more accurately; they don't take the place of them. Progress in machine learning techniques and ongoing research could potentially increase the rate of early detection, which would benefit those who are either diagnosed with or at risk of breast cancer.

1.1 *Catagories of breast cancer*

- Ductal Carcinoma in Situ (DCIS): A non-invasive breast cancer that starts in the milk tubes but does not spread to the surrounding breast tissue.

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- Invasive ductal carcinoma (IDC): Starting from the milk ducts, it spreads to the surrounding breast tissue. It could spread to other bodily areas if treatment is not received. Invasive lobular carcinoma: It can be circulated to other body parts and starts in the lobules that make milk. Compared to the IDC, it is less prevalent. Inflammatory breast cancer (IBC) is a kind of breast cancer that is very aggressive and not very common. This type often does not show a lump or tumor, but instead causes the affected breast to become red, swollen, or inflamed.
- Triple-negative breast cancer (TNBC) is identified as lacking estrogenic and progesterone receptors, as well as HER2/neu expression. Its nature is aggressive and does not respond to the use of hormone therapy or drugs acting on HER2 receptors. In HER2-positive Breast Cancer, it produces an excessive quantity of the HER2/neu protein that stimulates cancerous growth. Therefore, this form of cancer can be targeted using treatment options such as Herceptin.

1.2 *Symptoms of breast cancer*

1.2.1 *Lump or Thickening*

A discernible enlargement or thickening in the breast or underarm region, which may or may not cause pain. Changes in Breast Sizze: Asymmetry, deformity, or enlargement of the breasts are examples of abrupt changes in breast size or shape.

1.2.2 *Alterations in skin texture*

The breast skin may pucker or dimple, or it may become red, rash, or unusually warm.

1.2.3 *Modifications to the nipple*

Modifications to the Nipple, such as inversion (pulling inward) or unusual discharge (not breast milk) that may be transparent or bloody.

1.2.4 *Breast pain*

Although it is not always an indicator of breast cancer, persistent breast pain, that stays in one place, or doesn't go away with the menstrual cycle should be evaluated.

1.2.5 *Alterations in breast appearance*

Any variations in the appearance of one breast about the other, including abrupt, unexplained breast enlargement or shrinkage.

2 LITERATURE REVIEW

In the smart health computing environment, evolutionary computation techniques like genetic algorithms, classifiers, and support vector machines are emerging with time. Without the assistance of a person, this model can classify and recognize lesions linked to breast cancer[1]. An analysis of this model shows that it is superior to earlier approaches in that it can analyze the impacted patients' conditions through the detecting stage. Machine learning (ML) is extensively used in breast cancer model classification due to its leads in modeling essential feature detection from complex datasets [1,9]. [1] also, exhibit and evaluate numerous ensemble models and other alternatives of tested ML-founded models with and exclusive of the up-sampling method on two benchmark datasets. [2,10,13] shows the reasonable estimation of machine knowledge, deep learning, and data-extracting methods used to estimate breast cancer.

Support Vector Machines and Artificial Neural Networks have been known as better performers among all other classifiers. The research study [4,12] demonstrated the effectiveness of the classification method in detecting breast cancer at its initial stages. The results of this investigation are anticipated to stimulate further research on innovative approaches for early detection and diagnosis of breast cancer. The paper [5,14] has focused on the evolution of machine learning methodologies in cancer disease identification using learning algorithms that are tested with various algorithms. It is revealed through the result that Multilayer perceptron-based technique is more efficient than other techniques [6,15]. Figure 1 shows the various symptoms of breast cancer.

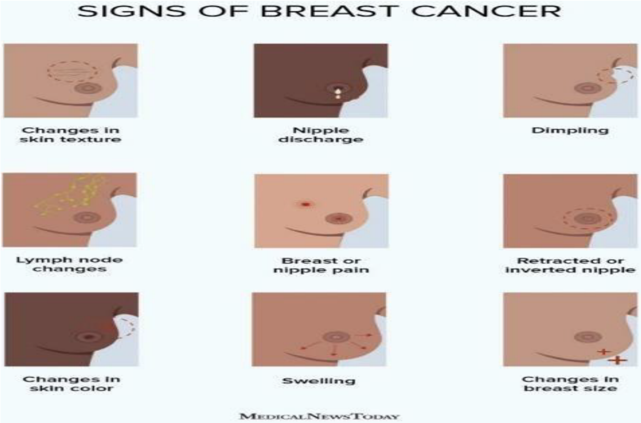


Figure 1. The various symptoms of breast cancer.

3 METHODOLOGY

In this part, we will address some of the classifiers widely utilized in machine learning to predict breast cancer. For instance, K-nearest neighbor (KNN), Gaussian Naïve Bayes, Support Vector Machine (SVM), and Decision Tree Classifier (CART) were implemented. Machine learning technologies have the following benefits: improving cancer detection and prognosis through early diagnosis, accuracy, personalized therapy, risk assessment, data fusion, predictive prognosis, as well as drug discovery. Such methods make it easier and faster to find potential substances and treatments for cancer treatment instead of the present time-consuming and error-prone process. There are several steps you have to undertake to employ the breast cancer dataset, the first one is loading the data into it. Then, we classify the data features (X) and labels (y) (Figures 3 and 4). As a preliminary step of quantifying the attributes, it is best to normalize or standardize them. It is also critical that we use this dataset in splitting training and test sets.

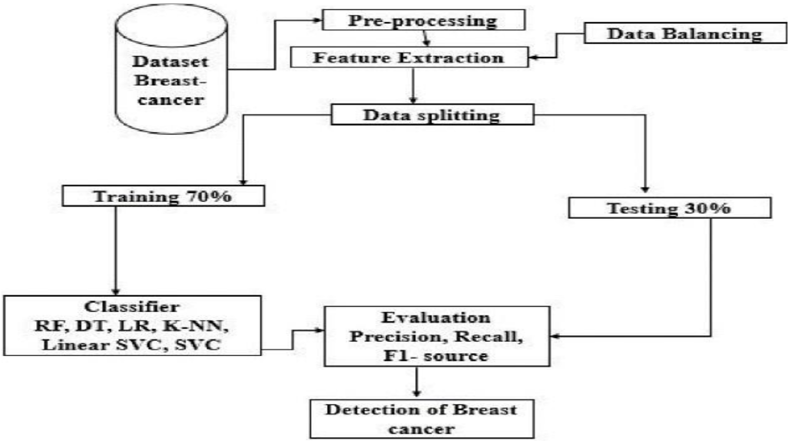

Dataset Breast-cancer
Pre-processing
Data Balancing
Feature Extraction
Data splitting
Training 70%
Testing 30%
Classifier RF, DT, LR, K-NN, Linear SVC, SVC
Evaluation Precision, Recall, F1- source
Detection of Breast cancer

Figure 2. Illustrates our suggested methodology.

3.1 *Analyses of dataset*

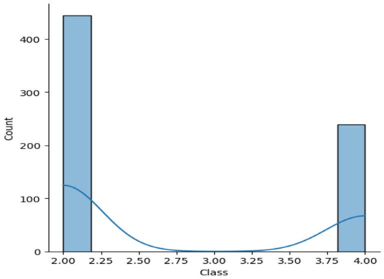


Figure 3(a). Alternative class outcomes occur.

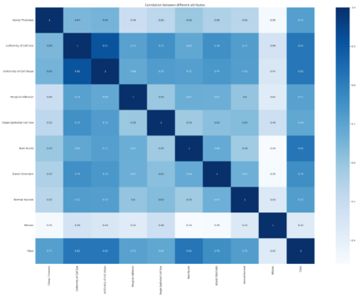


Figure 3(b). Heatmap.

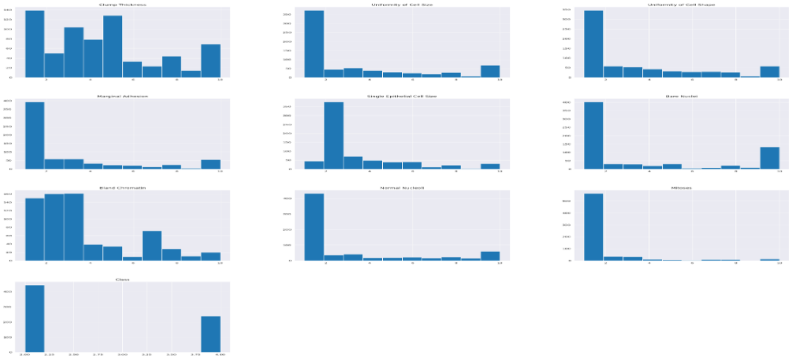


Figure 4. Multivariate analysis using a Histogram showing the frequency of each feature.

4 COMPARATIVE ANALYSIS OF MODELS

In the following part of this work, we are going to apply some analytic tools to compare four predefined machine learning procedures for the calculation of saccuracy. The list of these four algorithms is given as follows: as shown in Figure 5 SVM is one form of supervised machine learning, which is generally applied to regression and classification problems. SVM has been renowned for being able to tackle high dimensionality. Thus, it can be efficiently used for image recognition, text classification, and handwriting recognition tasks among others. The KNN algorithm is based on the computation of the average for dependent variables over its nearest neighbors while regression involves predicting the target value or arrival of a new data point using ANNs. In probabilistic classification, Gaussian Naive Bayes (NB) uses the Bayes theorem as its foundational base. It builds upon the original NB method that assumes a Gaussian distribution in features. Accuracy is a performance indicator that assesses how well a classification model forecasts successful results. In binary classification problems, it is particularly crucial to be able to differentiate between two classes, which are commonly referred to as the positive class and the negative class.

Recall is a performance indicator that assesses a classification model's ability to extract or capture each class's relevant occurrence. Recall is considerably more important when there is a substantial chance of missing positive examples (false negatives).

F1-score is the harmonic mean of precision and recall, is another statistic that provides a fair evaluation of a model's performance, especially when the positive and negative classes are out of balance.

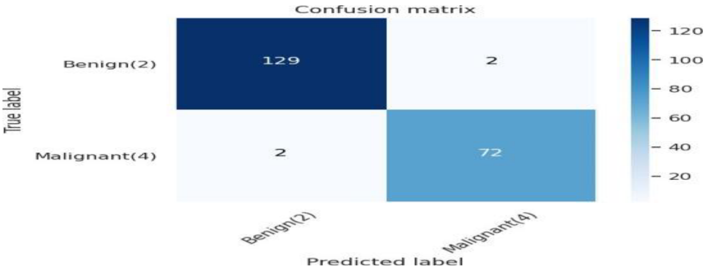
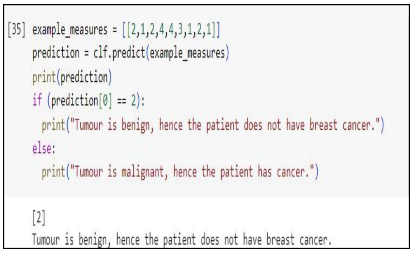


Figure 5. The accuracy of the SVM model concerning the anticipated outcomes is verified using a confusion matrix.

5 RESULTS AND DISCUSSION

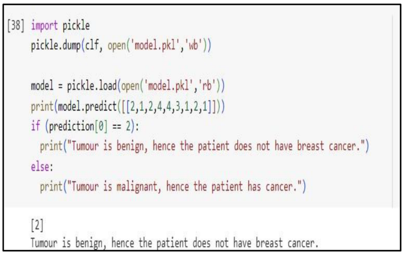
A way to serialize and deserialize Python objects is provided by the Pickle standard library module. When a Python object is converted into a byte stream, it is said to be serialized; conversely, when it is built back into a Python object from a byte stream, it is said to be deserialized. Pickle is a widely used tool for activities relating to object persistence, such as loading and saving machine learning models, and preserving configuration information.



```
[35] example_measures = [[2,1,2,4,4,3,1,2,1]]
     prediction = clf.predict(example_measures)
     print(prediction)
     if (prediction[0] == 2):
       print("Tumour is benign, hence the patient does not have breast cancer.")
     else:
       print("Tumour is malignant, hence the patient has cancer.")

     [2]
     Tumour is benign, hence the patient does not have breast cancer.
```

Figure 6(a). Shows the prediction value code.



```
[38] import pickle
     pickle.dump(clf, open('model.pkl','wb'))

     model = pickle.load(open('model.pkl','rb'))
     print(model.predict([[2,1,2,4,4,3,1,2,1]]))
     if (prediction[0] == 2):
       print("Tumour is benign, hence the patient does not have breast cancer.")
     else:
       print("Tumour is malignant, hence the patient has cancer.")

     [2]
     Tumour is benign, hence the patient does not have breast cancer.
```

Figure 6(b). Pickel prediction result.

Using an array as input i.e. Figure 6, determines if the patient has breast cancer or not. After standardizing the incoming data, we proceed to predict. As was previously mentioned, a subject with a score of 2 indicates that the subject does not have breast cancer, while a score of 4 indicates that they do. Using the pickle module i.e. Figure 6(b) to store the SVM model and predict the result. In the above case, the patient does not have breast cancer since the tumor class is 2 i.e. benign.

6 CONCLUSION

Using the Breast Cancer Wisconsin (diagnostic) dataset, this study investigates six distinct categorization models for breast cancer classification. The Python scikit-learn package is used for feature selection, while the Standard Scaler module is used for data processing. A multimodal set of machine learning methods, such as SVM, KNN, Gaussian Naïve Bayes, and CART, were used to create the models.

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Deepfake detection over different media types using deep learning algorithms

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ABSTRACT: The goal of this project is to create a deepfake detection model that is adaptable to several media forms, such as photos, videos, and audio recordings, by utilizing state-of-the-art deep learning techniques. It tackles the problems of detecting deepfakes in deteriorated video material and subtle audio alterations by combining convolutional neural networks (CNNs) for image and video analysis with Mel-frequency cepstral coefficients (MFCCs) for audio. The algorithm successfully learns to discriminate real content from altered content with 91 percent accuracy after thorough training on a variety of datasets. It also expands its capabilities to text detection, using a CNN architecture with FastText word embeddings to distinguish between text created by humans and text generated by bots. It performs better than existing deep learning models. This all-encompassing strategy emphasizes how powerful deep learning methods and sophisticated algorithms are at stopping the spread of false information and deepfake technology.

Keywords: Deepfake, convolutional neural networks, mesoscopic analysis, Mel-frequency cepstral coefficients

1 INTRODUCTION

Nowadays, everyone knows that fake news is commonplace, especially because over 10 crore hours of video clips are seen on social media platforms each day. There's growing concern over the spread of videos that have been altered. Even though picture manipulation detection has advanced, it is still difficult to identify videos that have been manipulated. Video manipulation is more challenging than image manipulation, mostly because video encoding compression results in frame loss. Video re-encoding and recapture detection is the main focus of current video forensics research; video editing detection is a major difficulty. Deep learning techniques have showed potential in digital picture forensics recently [10]. The rapid growth of Deep Fakes presents serious problems for social integrity, privacy, and reliability. Even though deepfake video detection remains the main focus of recent studies, audio manipulation is still a problem, especially when it comes to situations like hostile actors spoofing calls. However, compared to image and video recognition, deepfake audio detection hasn't received as much attention. Unlike video-based approaches, which use both audio and visual cues, audio-based detection methods just use sound signals, making them less researched.

2 LITERATURE SURVEY

Given the prevalence of manipulated content on the internet, detecting deepfakes has become increasingly important. Numerous research works have explored this field using various methods based on deep learning and computer vision techniques [10]. For example, Gupta *et al.* used Convolutional Neural Networks (CNNs) to analyze individual frames taken from

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films, with the goal of identifying telltale signals of tampering [7]. Avila and Keegan investigated the temporal dynamics of video sequences with Recurrent Neural Networks (RNNs) to find discrepancies caused by the creation of deepfakes. Other research, like that of Hong *et al.*, has concentrated on using micro-expression analysis to find minute clues that point to video tampering. Zhang *et al.* have suggested a method that uses Discontinuity-Induced CNNs to detect artifacts particular to GAN-generated false films [10]. These efforts illustrate the interdisciplinary nature of deepfake detection research, as well as the ongoing hunt for strong and effective detection approaches in the face of emerging adversarial techniques.

3 PROPOSED METHOD

3.1 *For video and image*

Through mesoscopic analysis, the suggested approach tackles the problems brought about by Deepfake and Face2Face videos. This means that it concentrates on an intermediate level of detail because higher semantic analysis has trouble identifying forged images, especially those featuring human faces, while microscopic analysis based on image noise is impractical in compressed video environments. MesoInception4: Deepfake image detection is the focus of the MesoInception-4 architecture, which is a variation of the Meso4 deep learning model. In an effort to enhance the model's capacity to capture features at different scales, it incorporates components from the conception module of Szegedy *et al.* The inception module, which takes the role of Meso4 first two convolutional layers, is essential to this architecture. To expand the model's optimization space and identify properties at various scales, this module stacks the outputs from multiple convolutional layers with distinct kernel shapes. To capture more contextual information without introducing unnecessary parameters, the inception module uses dilated convolutions instead of standard convolutions to enable a broader receptive field. Prior to applying these dilated convolutions, dimension reduction is achieved by applying 1×1 convolutions, which lower computational costs without sacrificing important characteristics [2]. To help gradient flow during training and promote feature propagation, a skip-connection is also added along with a parallel 1×1 convolution. ReLU activation functions are applied after convolutional processes, and then max-pooling and a dense network are used for classification. The output layer is made up of a single neuron that displays the likelihood that an input image is a deepfake using sigmoid activation. Overall, the Meso4 Inception architecture improves multi-scale information capture and feature representation by utilizing the inception module and dilated convolutions, which improves the performance of deepfake detection. [2]

3.2 *For audio*

The purpose of this study was to develop a system for identifying deepfake synthetic audio in a variety of background noise levels and audio lengths. The three primary stages of the framework are feature extraction, classification models, and data preprocessing as shown in Figure 1.

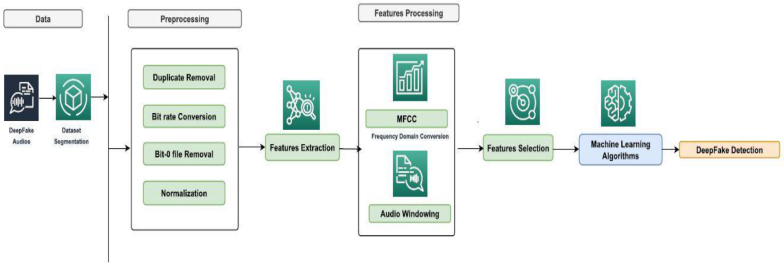

Figure 1. Identifying deepfake audio.

Preprocessing of data: Particular tasks including data handling, preprocessing, feature engineering, and classification are part of each phase [1]. To make model training easier, we also use conventional scaling to standardize the data.

Extraction of features: To accurately discriminate between authentic audio signals and deepfake ones, feature extraction is essential. We use a number of features in our analysis, such as signal energy, zero-crossing rate, spectral properties, and Mel-frequency Cepstral Coefficients (MFCC) [1]. In particular, MFCC is preferred because of its efficacy in speech recognition and its capacity to emulate human hearing. Following the initial signal processing stage, Mel-frequency cepstral coefficients (MFCC) are frequently calculated to describe the features of each frame in the audio waveform.

3.3 *For text*

The presence of unstructured or irrelevant material in datasets might hinder the training and performance of machine learning models. To improve model efficiency and simplify the data, preprocessing is essential. Tokenization, changing text to lowercase to handle case sensitivity, getting rid of stop words, and getting rid of digits are some of the steps [5]. Convolutional Neural Networks (CNN), Long Short-Term Memory (LSTM) networks, and a CNN-LSTM hybrid are among the deep learning models that are being used in the study. Utilizing the advantages of both CNN and LSTM, the CNN-LSTM ensemble model combines automated text vectorization with the capacity to identify long-term dependencies for enhanced performance.

$$w_{i,j} = \left[1 + \log\left(t_{f_{i,j}}\right)\right] \times \left[\log\left(\frac{N}{\mathrm{d}f_i}\right)\right] \tag{1}$$

where $\mathrm{tf}_{i,j}$ – The total amount of times t appears in document d; df_i – The quantity of documents that contain the word “t”; and N – total number of documents inside the corpus.

4 DATSET

4.1 *For video and image*

We created our own dataset as there wasn’t a complete collection of videos made using the Deepfake method. To train auto-encoders for forgery detection, enough diversity of faces had to be obtained, which meant gathering videos from different websites. We collected 175 forged video clips with minimum resolution of 854 × 480 pixels, ranging in length from two seconds to three minutes [7]. These videos were compressed at various levels to mimic real-world circumstances using the H.264 codec. The number of frames chosen for extraction from each movie was correlated with the frequency of changes in the target face’s illumination and camera angle, so ensuring a balanced distribution of faces. For reference, about fifty faces were taken from each scene.

4.2 *For audio*

About 195,000 speech samples, both human and synthetic, are collected in the Fake-or-Real (FoR) database [1]. These voices are taken from several datasets and text-to-speech programs such as Deep Voice and Amazon Polly. FoR-ORIGINAL, FoR-NORM, FoR-2sec, and FoR-REREC are its four available variations.

4.2.1 *FoR-ORIGINAL*

Audio samples with varying bit rates, durations, and noise levels are included in this dataset.

4.2.2 *FoR-NORM*

The for-norm dataset consists of audio recordings made at 12-second intervals.

4.2.3 *FoR-REREC*

It's a simulated voice recording of an attacker attempting to transmit a message via an audio channel, like a telephone call.

4.2.4 *FoR-2sec*

These audio files are based on the FoR-NORM dataset and have been truncated to two seconds.

4.3 *For text*

Building a dataset for the purpose of detecting deepfake text requires multiple strategies. Typically, researchers begin by collecting a diverse set of text samples from social media sites such as Facebook posts, Twitter messages, and Reddit comments. In order to discriminate between real and machine-generated text, these samples are manually tagged, which provides ground truth for evaluation and training [5]. Furthermore, synthetic or machine-generated text may be present in existing corpora used for natural language processing tasks; these corpora could be employed for study on deepfake detection. The diversity of the dataset can be increased even further by using data augmentation techniques like paraphrasing or changing already written content.

5 CLASSIFICATION AND EXPERIMENTATION

5.1 *FoR video and image*

Both of the trained networks in the Deepfake dataset are classified. Similar scores of about 90% are obtained by both networks when each frame is taken into account separately. Higher levels of video compression do, however, result in a discernible decline in scores [7]. Although the Xception network has performed better in picture classification on the Face Forensics dataset that we utilized for our experiments (Figure 2).

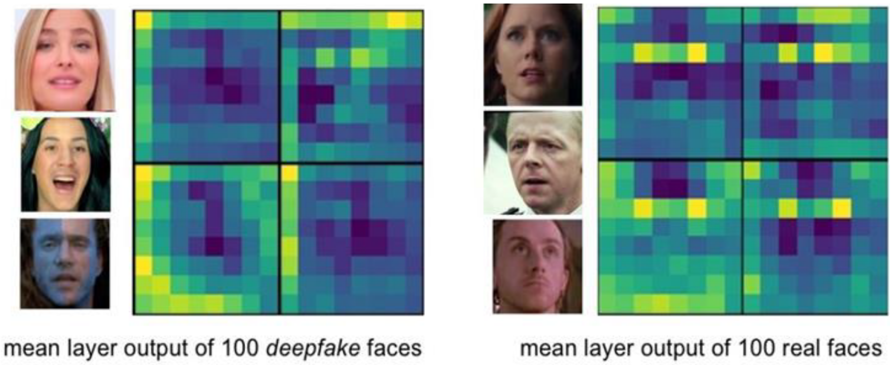

Figure 2. Final convolutional layer of MesoInception-4.

5.2 *FoR audio*

In terms of classification accuracy, our method shows great promise, especially when applied to ensemble-based machine learning models like boosting techniques. Notably, the accuracy of the XGBoost algorithm is higher than that of the baseline model. To mitigate this, performance can be improved by combining MFCC with dimensionality reduction strategies like windowing [1]. We contrast our proposed technique to the cutting-edge, using the FoR-ORIGINAL data for testing. Our suggested approach yields a substantially higher testing score of 93%, proving its effectiveness in detecting deepfake audio, in comparison to the best result recorded in earlier work using SVM (67%).

5.3 *FoR text*

This section outlines the tests used to detect counterfeit text and discusses the results obtained. Several feature engineering techniques are used to assess the effectiveness of supervised machine learning models, including word embedding techniques like FastText as well as frequency-based approaches like TF and TF-IDF [5]. The following models are also considered: Decision Tree (DT), Logistic Regression (LR), K-nearest neighbors (KNN), Random Forest (RF), Gradient Boosting Machine (GBM), Extra Tree Classifier (ETC), Naive Bayes (NB), and Stochastic Gradient Descent Classifier (SGC). These models are evaluated using metrics mentioned in Table 1.

Table 1. Classification results using the TF-IDF algorithm.

Model	Accuracy	Precision	Recall	F1-Score
RF	91%	91%	91%	91%
ETC	91%	91%	91%	91%
LR	83%	69%	83%	76%
SGC	75%	80%	75%	77%
NB	83%	69%	83%	76%
KNN	66%	65%	66%	71%

6 DISCUSSION AND CONCLUSION

According to their examination, the combination of CNN and RNN produced the best validation accuracy (82.81%), with grayscale histogram analysis and eye blink detection coming in second and third, respectively, at 81.67% and 81.32%. The study emphasized the importance of grayscale histograms and demonstrated a thorough knowledge of deepfake movies [2]. However, it also emphasized a key downside of high false positives, highlighting the need for additional improvement for practical usefulness in real-world circumstances. Experiments show that the approach can detect Deepfake movies with an amazing average detection rate of 98%. This work uses the FoR dataset, a state-of-the-art resource for audio detection and classification, to expand on earlier research on deepfake audio detection. Overall, over these datasets, our feature outperforms conventional feature-based techniques by an average of 10 to 20 percent [2]. Nevertheless, our method with basic SVM algorithms performs poorly on the for-norm dataset, indicating that windowing strategies combined with MFCC might produce better outcomes. For example, the SVM model achieves the highest accuracy of 97.57% while utilizing the for-2sec dataset, while the Gradient Boosting classifier achieves 92.63% accuracy with the for-norm dataset [1]. Moreover, the SVM model performs exceptionally well, obtaining an accuracy of 98.83% on the for-rerec dataset. Future studies should investigate various MFCC window sizes as well as varied model input sizes. The study examines the suggested model's accuracy, precision, and recall trends during both training and testing phases. FastText improves precision in all models, but CNN outperforms the others. CNN-LSTM with FastText Subword produces the lowest recall values [5]. Among the deep learning models tested, CNN with FastText has the highest F1 Score of 0.93.

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Screening, docking and ADME studies of the phytochemicals present in *Rhododendron Arboreum Sm.* against myocardial infraction through computational approaches

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ABSTRACT: Medicinal plant Buransh is very popular for its flower and juice from the family Ericaceae known as *Rhododendron arboreum* Sm. contains potential phytochemicals as quercetin, ursolic acid, Hyperine, taraxerol, betulin, lupeol and sitosterol, etc. Traditionally this plant was used to treat nasal bleeding, blood dysentery, heart problems, asthma, and diabetes, etc. The aim and objective of the current study is to examine drug-receptor binding affinity and calculate different properties prediction along with bioavailability properties prediction through absorption, distribution, metabolism and excretion (ADME) of phytocompounds established in *Rhododendron arboreum* Sm plant parts. In this *in silico* study, more focus on pharmacokinetic parameters, bioavailability, lipophilicity, solubility, properties like drug and important chemical structure properties prediction was performed to know the important phytocompounds for the drug candidate in different therapeutic purpose like cardioprotective properties. The discovery from these explorations cab be further traversed to detect the pinpoint pharmacological procedures fundamental to conventional medicinal plants.

Keywords: *Rhododendron arboreum Sm.*, swissADME, phytochemicals

1 INTRODUCTION

Rhododendron arboreum Sm. from Family Ericaceae is a well-known medicinal and therapeutic plant commonly known as 'buransh'. It is a popular and known for various therapeutics; antiinflammatory, antidiarrheal, antiviral, antidiabetic, etc [1–3]. Due to the presence of various potential phytoconstituents; significance of buransh plant including all of its parts is still in ongoing research [4,5]. Myocardial infraction is a condition of ischemic heart disease, as buransh has been shown cardioprotective action; it may show active potential agent against different type of heart disease. [7–9]

1.1 *Common phytochemicals present in Rhododendron arboreum Sm.*

3-O-acetylbetulinic acid, 3-O-acetylursolic acid, Alpha amyrin, β amyrin, Beta-sitosterol, Betulin, Betulinic acid, Campanuline, Epifriedelinol, Friedelin, Lupeol, p-coumaric acid, Quercetin, Quercetin-3-O-galactoside, Quercitrin, Rutin, Taraxerol, Ursolic acid. [10–13]

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2 OBJECTIVE

Objective of this study to investigate pharmacokinetic properties and drug likeness of different phytochemicals present in *Rhododendron arboreum Sm.* through docking and ADME studies against myocardial infraction.

3 LITERATURE REVIEW

In the year 2023, Mehta J. *et al.* investigated and examined antibacterial profile of *Rhododendron arboreum Sm.* phytochemicals by using extraction and computational approaches specifically docking and ADME studies. [14] Pradhan A. *et al.* in 2023 examined cardioprotective nature of *Rhododendron arboreum Sm.* due to free radical scavenging property against doxorubicin induced cardiotoxicity in wistrar rat. [15] According to Bisht A. *et al.* in 2023 [16], Quercetin has positive effects on various cardiovascular conditions. In the year 2022, Ahmad P. *et al.* also focused upon cardioprotective activity of *Rhododendron arboreum Sm.* as a traditional use. [17] Sharma M. *et al.* in 2022 [18] and Khan WA. *et al.* in 2022 [7] studied the medicinal uses cardioprotective nature of ethanolic extract of *Rhododendron arboreum Sm.* Swamidasan R. *et al.* in 2020 [13] explained about different phytoconstituents of *Rhododendron arboreum* and its activity against myocardial infraction by elevating serum cardiac marker enzyme LDH, AST and ALT. Verma K. *et al.* in 2020 discussed about different bioactive compounds and biological activity of *Rhododendron arboreum Sm.* Along its cardio protective nature may be due to flavonoids. [19] Madhvi SK. *et al.* in 2019 [20] mainly focused about potential phytochemical chemicals structures along with traditional uses and biological activity of *Rhododendron arboreum Sm.* Mudagal MP. *et al.* in 2018 [21] investigated preventive activity of *Rhododendron arboreum* against myocardial ischemia in rat myocardium induced by isoproterenol. In continuation with cardio activity discussed in different studies; in 2018, Bhatt N. also studied, confirmed cardio protective action of buransh and improvement of cardiac function, due to Flavonoids. [22] Next good cardioprotective action of ethanolic extract was also studies by Parcha V. *et al.* in 2017 in ischemic heart. According to above literature Rhododendron *arboreum Sm.* has shown cardioprotective action as traditional use, medicinal use, biological use, etc. Further studies could be done for its significance action by computational approaches because this plant contain various potential phytochemicals which are far better than synthetic compounds in terms of therapeutic action. [23]

4 MATERIALS AND METHODS

4.1 *Materials*

Chemical structure of eighteen selected phytochemicals and Nitroglycerin as the comparative standard drug were identified from the database pubChem [24] & drawn with the help of ChemDraw Ultra [25]. Compounds were downloaded in .sdf, .pdb and .smiles format. The macromolecular proteins ALDH2(4FR8) that relate to cardio-protective action was searched by Therapeutic Target Database (TTD) [26] and confirmed as well as retrieved from the database of RCSB Protein Data Bank in 3D .pdb format file [27]. Along this online tool like swissADME was also used for ADME properties. The software that were used in this study are Pyrx and AutoDock mgl tool [28].

4.2 *Methods*

4.2.1 *Molecular docking study*

The study of phytochemical compounds activity against a target receptor was performed using Pyrx and AutoDock mgl tool .The result of binding affinity as a docking score was presented as the binding affinity value in respective docking table.

4.2.2 *ADME Properties calculation:*

Pharmacokinetic properties calculation for prediction of 18 phytochemical compounds conducted using SwissADME online server and shown the ADME data prediction for the potential phytochemicals.

5 RESULTS AND DISCUSSION

5.1 *Drug receptor interaction calculation*

Following are the docking results (Table 1) of phytochemicals with receptor protein ID 4FR8.

Table 1. Docking results of various phytochemicals from *Rhododendron arboreum Sm.* [28].

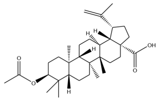
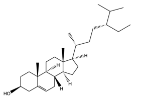
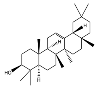
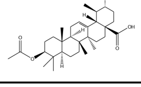
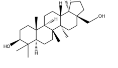
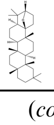
Phytochemica0ls	Binding score (KCal/mol)	Phytochemicals	Binding score (KCal/mol)
3-O-acetylbetulinic acid	−7.9	Friedelin	−5.2
3-O-acetylursolic acid	−6.4	Lupeol	−7.1
Alpha amyrin	−7.5	p-coumaric acid	−6.9
Beta amyrin	−6.9	Quercetin	−6.8
Beta-sitosterol	−7.2	Quercitrin	−6.8
Betulin	−6.4	Rutin	−7.3
Betulinic acid	−7	Taraxerol	−7.7
Campanuline	−7.1	Ursolic acid	−8
Epifriedelinol	−6.9	Nitroglycerin (Std)	−3.6
Quercetin-3-O-galactoside	−6.7		

For better therapeutic action proper binding of ligand compounds with receptor protein is very important step. For this docking studies was performed using pyrx-AutoDock tools [28] and scores were calculated in terms of binding affinity having RMSD value zero. All the binding affinities was very good with the receptor if we compare with standard. RMSD value ≦ 2Å is always considered as good parameter.

5.2 *ADME prediction*

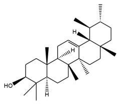
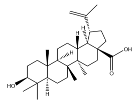
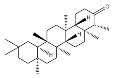
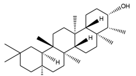
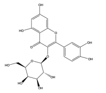
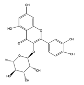
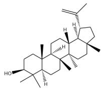
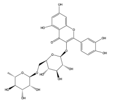
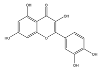
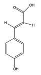
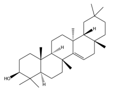
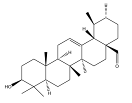
Firstly, prediction of ADME requires .SMILES format on the basis of chemical structure (as mentioned in Table 2) of various phytochemical compounds.We access ChemDraw and PubChem server for retrieving SMILES files and estimate ADME prediction properties of phytochemicals with the help of swissADME online server.

Table 2. Chemical Structures of the phytoconstituents of *Rhododendron arboreum Sm.* By ChemDraw software [25].

Phytochemical	Chemical structure	Phytochemical	Chemical structure	Phytochemical	Chemical structure
3-O-acetylbetulinic acid		Beta-sitosterol		Beta amyrin	
3-O-acetylursolic acid		Betulin		Campanuline	

(*continued*)

Table 2. Continued

Phytochemical	Chemical structure	Phytochemical	Chemical structure	Phytochemical	Chemical structure
Alpha amyrin		Betulinic acid		Friedelin	
Epifriedelinol		Quercetin-3-O-galactoside		Quercitrin	
Lupeol		Rutin		Quercetin	
p-coumaric acid		Taraxerol		Ursolic acid	

Then we have calculated the physicochemical parameters for the different phytochemical of Rhododendron *arboreum Sm.* Table 3 shown the different physicochemical parameters of the selected phytochemical of *Rhododendron arboreum Sm.* as molecular and physicochemical parameters for example molecular weight, heavy atom numbers, rotatable bond numbers, Hydrogen bond acceptors, hydrogen bond donors, MR and TPSA, etc are all included in this Table 3 [29].

Table 3. Physicochemical characteristics of plant constituents of *Rhododendron arboreum Sm.* [29–31].

Phytochemical	MW	HA	RB	HBA	HBD	MR	TPSA
3-O-acetylbetulinic acid	498.74	36	4	4	1	146.65	63.6
3-O-acetylursolic acid	498.74	36	3	4	1	146.65	63.6
Alpha amyrin	426.72	31	0	1	1	135.14	20.23
Beta amyrin	426.72	31	0	1	1	134.88	20.23
Beta-sitosterol	414.71	30	6	1	1	133.23	20.23
Betulin	442.72	32	2	2	2	136.3	40.46
Betulinic acid	456.7	33	2	3	2	136.91	57.53
Campanuline	426.72	31	0	1	0	133.2	9.23
Epifriedelinol	428.73	31	0	1	1	135.36	20.23
Friedelin	426.72	31	0	1	0	134.39	17.07
Lupeol	426.72	31	1	1	1	135.14	20.23
p-coumaric acid	164.16	12	2	3	2	45.13	57.53
Quercetin	302.24	22	1	7	5	78.03	131.36
Quercetin-3-O-galactoside	464.38	33	4	12	8	110.16	210.51
Quercitrin	448.38	32	3	11	7	109	190.28
Rutin	610.52	43	6	16	10	141.38	269.43
Taraxerol	426.72	31	0	1	1	134.88	20.23
Ursolic acid	456.7	33	1	3	2	136.91	57.53
Nitroglycerin (std)	227.09	15	8	9	0	44.1	165.15

Table 3 shown the essential drug like properties values of the selected phytochemical of *Rhododendron arboreum Sm.* Only p-coumaric acid and Quercetin compounds met those properties required to and drug according to the Lipinski's rules like standard drug affter that we have identified different pharmacokinetic parameters of the phytochemicals.

6 CONCLUSION

This study findings that all the selected phytochemicals of *Rhododendron arboreum Sm.* shown good binding with receptor 4FR8 and few phytochemicals met the different essential properties according to Lipisnki's rule. The docking studies and analysis results shown that phytochemicals specifically p- coumaric acid and Quercetin were having better interaction scores, follows essential rule for drug like properties i.e. high gastrointestinal absorption, soluble nature and good bioavailability. According to these results study may be proceed further for betterment of therapeutics.

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Improved plant leaf disease classification using meta-heuristic algorithm based deep learning

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ABSTRACT: The proposed work detects plant leaf diseases in paddy, where preprocessing involves Laplacian filter and adaptive histogram equalization (AHE) to improve the quality of images. Fusion background removal is used along with HSV color mode and thresholding. A suitable data augmentation techniques using ANN-GAN is used to attain a balanced dataset. Feature extraction involving geometric transformations, contrast adjustments, brightness modifications, and saturation modifications are used to improve the feature extraction ability. Disease spots are segmented using KNN on augmented images and finally the classification stage employs a DBN-ACO approach, combining Deep Belief Networks (DBN) for feature extraction and Ant Colony Optimization (ACO) for classification. These results show an accurate disease classification than other existing methods.

Keywords: ACO, DNN, K-means, paddy leaf, disease classification

1 INTRODUCTION

Agriculture is a substantial source of income for a large number of people in a number of different countries [1]. The specific environmental conditions of the land and the demand for food plants are taken into consideration by farmers when harvesting the various food plants. Despite this, farmers are facing a multitude of obstacles, including catastrophic natural disasters, a lack of available water, and diseases that affect plants [2]. By providing a number of different technological conveniences, the bulk of problems can be reduced. There are a few processes involved in the process of recognizing diseases through the use of image processing. These steps include picture capture, image pre-processing, image segmentation, feature extraction, and eventually classification.

2 RELATED WORKS

According to [10], a deep convolutional neural network was utilized in the development of a novel approach to the detection of diseases that affect rice plants. The dataset that was utilized in this investigation consists of five hundred photographs that depict paddy stems and leaves that are either infected or completely free of disease. The technique of classification involves the examination of ten diseases that are commonly found in rice cultures.

It was introduced by [13] that a unique method, the purpose of classifying the illness into several categories, the researchers utilized the Naïve Bayes classifier, which is a straightforward classification technique. The authors of [14] devised a method that makes use of utilizing in the process of feature extraction. In order to differentiate between diseased and normal plants, the collected characteristics were utilized by a number of different classifiers

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3 PROPOSED WORK

In this section, the proposed method is illustrated in Figure 1.

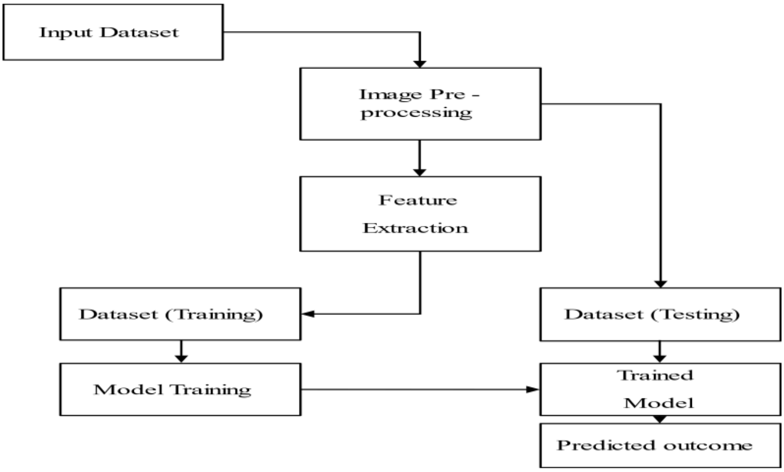

Figure 1. Proposed leaf disease detection.

3.1 *Preprocessing paddy leaves*

The initial step of the process involves applying a Laplacian filter to the monochromatic image to carry out some form of pre-processing. The images that are included in the dataset are scaled down and cropped so that they have a measurement of 300 by 450 pixels when they are processed in the preprocessing stage. A mask is created by combining an RGB image with a binary one that was produced by applying a threshold value of 90.

3.2 *Laplacian filter for noise removal*

A technique known as the Laplacian function, which is a second-order derivative, is utilised in the process of enhancing images to achieve the desired results. It can recognise extremely minute features that are concealed within an image.

3.3 *Adaptive histogram equalization (AHE)*

In most cases, remapping an image grayscale is required to perform histogram equalisation. This is done to ensure that the final histogram has a distribution that is equivalent to that of a uniform histogram. In contrast, adaptive histogram equalisation (AHE) does not incorporate this process in any way

3.4 *Data acquisition and augmentation*

The use of data augmentation allows researchers to work with datasets that do not have an even distribution throughout the entire collection. The research can resolve the situation by achieving a uniform distribution of the data through the implementation of ANN-GAN enhancement techniques within the image generation process. This allows us to bring about an even distribution of the data.

3.5 *Data augmentation using Ann-Gan*

ANN-GAN can be used for the purpose of generative modelling is the use of representative models in ANN-GAN. Generative models are utilised to make projections regarding data distributions that were not previously known to the user. Because the research used a deep neural network as the foundation for the construction of a ANN-GAN, the research can model discriminatively by replicating the data distribution.

3.6 *Detection*

In this specific instance, the research use DBN-ACO to answer the problem of image classification so that the research can determine which diseases affect the leaves of plant plants. There are three distinct phases that make up the classification method: the pre-processing stage, the feature extraction stage, and the classification stage.

3.7 *Preprocessing*

Figure 1 illustrates the flow of the model. A typical learning environment that covers the entire process from beginning to end does not require any pre-processing at all. In most cases, preparation is not required because of the characteristics of the data that is accessible for end-to-end input training procedures.

3.8 *Data augmentation and feature extraction*

When the images of the items of interest undergo changes in size, orientation, or position, it is particularly challenging for CNN to make accurate predictions.

3.9 *Data augmentation*

When images of the objects of interest experience changes in size, orientation, and placement, CNNs are required to make predictions that are exceedingly demanding. The network must be able to handle all of these variations in a methodical and effective manner. Feature Extraction.

3.10 *Brightness adjustments*

Changes in the illumination of the surrounding environment can cause a significant disparity in the brightness of an image. The equation that follows illustrates the gamma transformation, which is a method of converting varying amounts of gamma values into images with and without illumination. In spite of the fact that the acquired images were subjected to such lighting-induced changes, this alteration assisted in enhancing the variances. When it comes to mobile phones, the quality of the sensors might vary quite a little from one individual to the next. Most low-cost mobile phones have terrible cameras that are not very good at capturing colors and are not very good overall. In this section, the diseased spots are detected for possible extraction of features during the process of feature extraction. The probability that the spots in the leaf is considered as the fraction of the samples being labelled as diseased during the process of training. The augmented images are rigorously applied with KNN for possible segmentation of leaf disease spots than the existing methods. After the preliminary processing stages have been finished, the results of the feature extraction are then entered into a DBN classification. The RBM in DBN oversees the extraction of the characteristics, and the MLP is the one responsible for classifying those characteristics. The contrastive divergence method, which is a technique in which input is provided to the visible neurons based on the trained samples that have been selected, is utilised in this research.

4 RESULTS AND DISCUSSION

In this section, the simulation is conducted in python that runs on a i7 processor with 16 GB RAM. The proposed method is compared with existing deep belief network and RNN over training and testing set.

From the results, it is seen that the proposed method achieves higher accuracy, precision, recall and f-score than the existing methods which are shown in Figures 2 to 5.

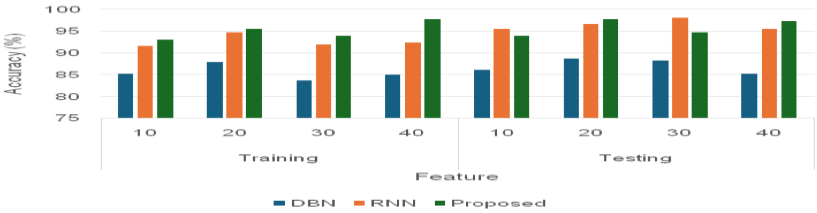

Figure 2. Accuracy.

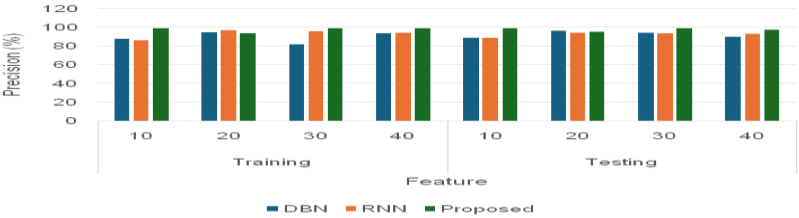

Figure 3. Precision.

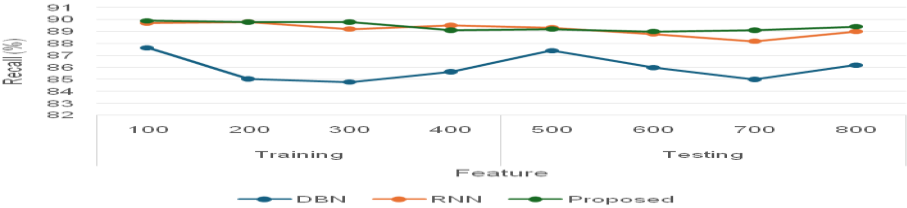

Figure 4. Recall.

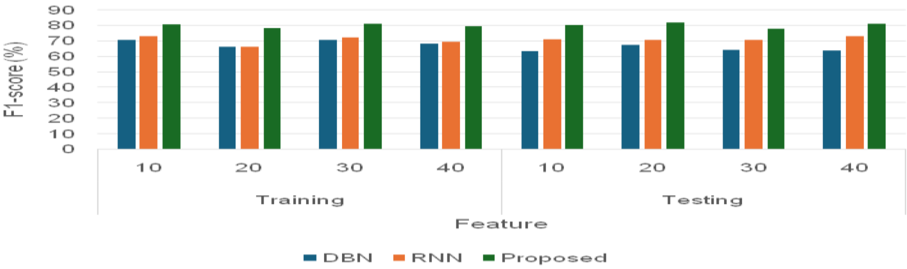

Figure 5. F1-score.

5 CONCLUSION

In conclusion, the proposed methodology offers a robust framework for automated detection of leaf diseases in paddy plants. By combining various preprocessing techniques such as Laplacian filtering and adaptive histogram equalization with advanced data augmentation methods like ANN-GAN, the model ensures high-quality input data for classification. Furthermore, the segmentation of disease spots using KNN on augmented images enhances the accuracy of feature extraction. The utilization of DBN-ACO for classification addresses challenges such as local optima and convergence rate, resulting in more precise disease classification. Overall, this comprehensive approach covers preprocessing, feature extraction, and classification stages, providing a holistic solution to the problem of leaf disease detection. By leveraging cutting-edge techniques from image processing and machine learning, the proposed framework shows promising potential for practical implementation in agricultural systems, contributing to improved crop health management and increased agricultural productivity.

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Machine learning approaches for early hemorrhagic stroke prediction

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ABSTRACT: This study intends to develop a prediction model for hemorrhagic stroke using machine learning techniques. The emphasis is on designing a robust prediction system capable of reliably identifying people at risk. Materials and Methods: The present study comprised two groups. Group 1 refers to a Support Vector Machine (SVM) approach with high gradient boosting, whereas Group 2 belongs to the Convolutional Neural Network technique that enhances accuracy and produces faster results. Results: The review examines several methods, with a special emphasis on Convolutional Neural Networks (CNN), which achieve outstanding accuracy levels of 97%, while the existing approach of support vector machines reaches 96% in prediction. Conclusion: Within the limits of this study, the Convolutional neural network achieves exceptional accuracy in predicting hemorrhagic stroke.

Keywords: Hemorrhagic, Stroke, Deep Learning, Convolutional Neural Networks, Support Vector Machines, Machine Learning, Extreme Gradient Boosting, Supervised Learning

1 INTRODUCTION

The Convolutional neural network achieves exceptional accuracy (97%) in predicting hemorrhagic stroke, A thorough study of 21 research testing stroke classification scores revealed that the Siriraj Score outperformed the others and used a supervised machine learning technique. According to a comparative study, the Siriraj Score exceeds the others [1]. The calculated and reported sensitivity ranges for the Siriraj Score (hemorrhagic stroke diagnosis) are much greater than those for the other scores, suggesting that the included studies overestimated their performance. Greek and Guys Hospital/Allen scores show similar patterns. Performance is estimated accurately with the help of the proposed weighted accuracy metric [2]. The study studies clinical, metabolic, and neuroimaging markers in stroke patients, using machine learning, specifically Random Forest (RF), to predict death and morbidity three months after admission. With 6022 patients, RF consistently predicts steady mortality. The International Council for Harmonization (ICH) group faces challenges in predicting mortality. Morbidity is slight distinctions between the IS and IS + ICH groups., with statistical discrepancies verified by a paired Wilcoxon test. In conclusion, RF helps predict long-term outcomes in stroke patients [3]. The research focuses on leveraging machine learning methods to accurately forecast hemorrhagic transformation post-ischemic stroke. By incorporating diverse clinical, imaging, and demographic data, the study aims to create a predictive model facilitating early intervention and personalized treatment plans for

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enhanced patient outcomes. In a retrospective multicenter experiment, a Lasso Logistic Regression model was established utilizing the OMOP Common Data Model and a large dataset of US medical records. The model, which was independently evaluated across ten different datasets from America, Europe, and Asia, identified 612 risk factors of hemorrhagic transformation (HT) following an ischemic stroke. Internal validation provided an AUC of 0.75, while external validation across 5,515,508 patients obtained a mean AUC of 0.71 [4,5].

2 RELATED WORKS

In the rapidly developing healthcare sector, the use of methods such as machine learning has changed the game. The upcoming literature review examines the complex relationship between medical research and artificial intelligence from the perspective of comparing the relative merits of two well-known approaches: Support Vector Machines (SVM). Machine learning is being used in every field of business and research, including medicine, at an exponential rate. In order to save doctors, radiologists, and other medical professionals time in analyzing, forecasting, and accurately diagnosing illnesses, this book explains how machine learning (ML) and deep learning (DL) algorithms can be integrated [7]. ML/DL paradigms in healthcare and develops algorithms and solutions to address real-world biological problems. It offers cutting-edge approaches in medical data analytics and healthcare applications to a wide range of audiences, equipping them with unique solutions and analytical insights [6]. Using ensemble learning, the methodology incorporates both structured and textual data, providing a unique way of predicting stroke outcomes. This novel method leverages the ability to merge many data modalities to improve outcome prediction accuracy via training [8]. A detailed evaluation of stroke incidence is conducted, with a particular emphasis on the primary pathogenic categories detected and trends reported by the Auckland Regional Community Stroke Study. The investigation delves into the many elements of stroke incidence in this geographical population [13]. In this collaborative effort, many machine learning and deep learning approaches in Extreme Gradient Boosting with supervised Learning medical research are fully investigated. The emphasis is on identifying prospective applications and investigating the advances they bring to the discipline [15].

3 MATERIALS AND METHODS

Hemorrhagic stroke subtypes can be precisely classified using the CSV dataset and the proposed system by using stringent feature selection techniques like Recursive Feature Elimination (RFE). When using RFE, the model gets good accuracy and precision. The research employed clinical data, ensuring a 96% confidence interval and 97% accuracy at a significance level of 0.05%. The dataset contained crucial stroke-related parameters, and the evaluation employed machine learning techniques to increase predicted accuracy. In the current research on machine learning algorithms, there are two groups. In this current research, on Hemorrhagic stroke, there are two groups.

Group 1 refers to the study of existing systems and focuses on the usage of existing systems, notably the Support Vector Machines (SVM). This group has a dataset of ten samples. The research provides prediction accuracy for Support Vector Machines.

Group 2 requires machine learning approaches such as Convolutional Neural Network (CNN) to accurately predict hemorrhagic stroke. Using comprehensive Feature Selection and training with Recursive Feature Elimination and Convolutional Neural Networks yields great accuracy in detecting hemorrhagic stroke risks.

4 CONVOLUTIONAL NEURAL NETWORK

Figure 1 illustrating the Convolutional Neural Network with the RFE process is a feature selection technique that iteratively refines the feature set by recursively removing less informative features, hence improving model performance and limiting overfitting. Every iteration involves selecting a current selection of characteristics for the model to be trained on, and assessing each feature's significance. Features of lower importance are subsequently removed, and the procedure is continued until the desired number of features is obtained.

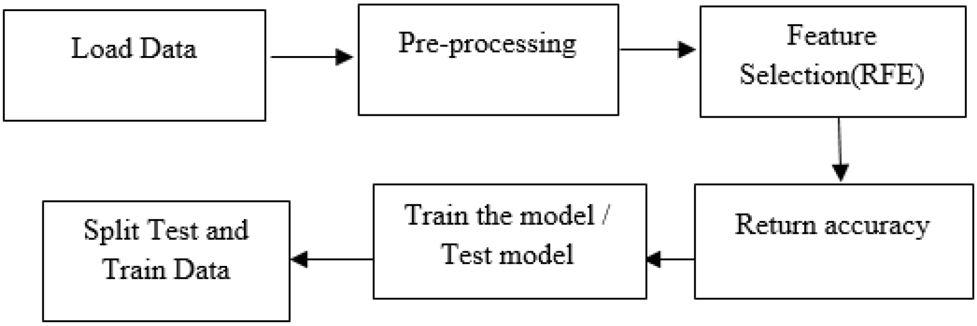

Figure 1. Convolutional neural network (CNN) models are created for training and evaluating data as part of the machine learning process.

5 RESULTS

According to the study's results analysis, various machine learning algorithms varied in their ability to predict hemorrhagic strokes using the given information. The Convolutional Neural Network showed a high predicting accuracy of 97%, with a respective accuracy of 96%, Support Vector Machine (SVM) with supervised Learning showed the next highest performance (Figures 2 and 3). When it comes to predicting the accuracy of machine learning algorithms for hemorrhagic stroke, CNN and SVM are a good fit. When comparing the accuracy of predictive models for hemorrhagic stroke, Convolutional Neural Networks perform better than other models, with a 97% accuracy rate.

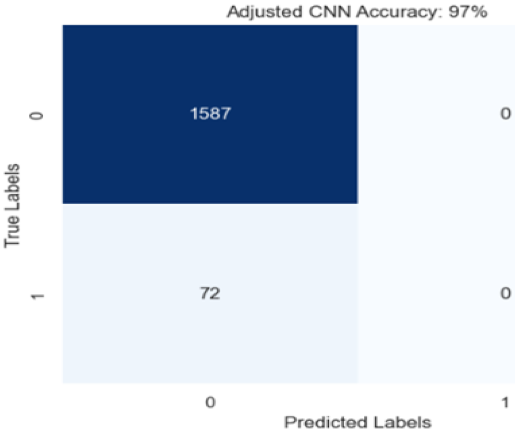

Figure 2. The capacity of the convolutional neural network (CNN) accuracy prediction graph to distinguish between real negative and true positive values in its predictions is shown.

People who are at risk of hemorrhagic strokes, as seen by their high accuracy scores. This suggests that these algorithms are capable of managing the intricacies and patterns found in the stroke prediction dataset. These high accuracies indicate a high degree of trust in the predictions produced by these models, which is encouraging for possible clinical applications.

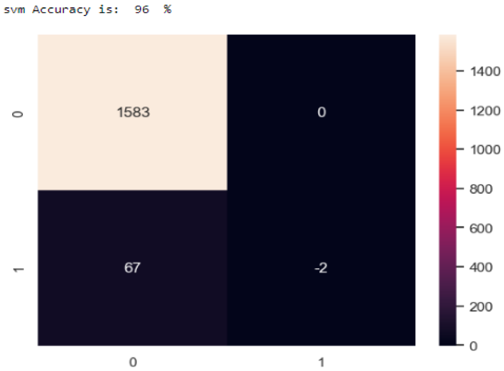

Figure 3. The support vector machine (SVM) accuracy prediction graph shows how the model determines real positive and true negative values in its predictions.

Furthermore, cross-validation on more datasets would improve the generalizability of the findings. Researchers can determine whether the performance seen in this study holds across various demographics or data distributions by testing the models on a variety of datasets. This increases the predictive model’s usefulness in clinical practice for identifying patients at risk of hemorrhagic strokes by ensuring their robustness and reliability across a range of real-world settings.

6 DISCUSSION

Stroke, a major worldwide health concern, is addressed using machine learning models that incorporate physiological information. Convolutional Neural Network outperformed, attaining 97% accuracy on the Stroke Prediction dataset, demonstrating higher reliability than previous studies. Advancements in data-driven approaches have revolutionized the prediction and detection of hemorrhagic strokes, showcasing remarkable accuracy and effectiveness in medical applications. This discussion explores recent breakthroughs in predictive models, deep learning techniques, and their potential impact on medical diagnosis and treatment. Recent studies have demonstrated the efficacy of various data-driven models in predicting hemorrhagic strokes with high accuracy. For instance, a model based on Convolutional Neural Networks (CNNs) achieved an impressive 95.2% accuracy in detecting early signs of hemorrhagic strokes by Supervised machine learning technique [14]. Moreover, an ensemble model that combined deep learning approaches with Extreme Gradient Boosting and gradient boosting produced a prediction accuracy of 96.8%, surpassing conventional methods [15].

7 CONCLUSION

The paper highlights the effectiveness of SVM and CNN algorithms for hemorrhagic stroke prediction and looks at data-driven approaches. CNN has more accuracy (97%) than SVM

(96%), indicating that it is a viable option for trustworthy risk assessment. Intending to supply decision-makers and medical professionals with useful information, this study highlights the necessity of utilizing machine learning models to precisely forecast hemorrhagic strokes. Within the constraints of this study, the Convolutional neural network model exhibits outstanding accuracy in predicting hemorrhagic stroke.

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Machine learning based optimization of resource management with control strategies in smart grid using IoT

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ABSTRACT: The research explores an IoT system for forecasting energy consumption in distribution stations using smart sensors and machine learning models. Real-time data collection and experiments demonstrate strong correlations between sensor readings and power consumption, with the ANN model achieving high accuracy. Naive Bayes, Random Forest, and Decision Trees also show competitive results. The study evaluates the models' comprehensibility, computational efficiency, and adaptability for practical use. Integrating IoT and machine learning improves real-time monitoring and predictive analytics, optimizing resource allocation in smart grid environments. These findings lay the groundwork for more efficient and sustainable energy management systems.

Keywords: IoT, Machine Learning, Power Consumption Prediction, Smart Grid, Energy Management

1 INTRODUCTION

The evolution of power distribution systems is at a critical stage, requiring innovative solutions to meet the increasing complexity and demands of modern power networks. This research aims to revolutionize the landscape of smart grids by introducing an Internet of Things (IoT) system combined with machine learning techniques to accurately monitor and predict energy consumption in distribution stations. Recent literature focuses on the strategic placement of IoT devices in power distribution systems to improve network efficiency. By strategically placing sensors such as current sensors, voltage sensors, and smart meters, continuous monitoring of the energy system is ensured, providing real-time data to respond to fluctuations in energy consumption [4,5]. Smart meters at the consumer level act as a

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conduit for real-time energy consumption data and contribute to accurate load forecasting models. Machine learning techniques, including Artificial Neural Networks (ANN), Naive Bayes (NB), Random Forest (RF), and Decision Trees (DT), have emerged as powerful tools for predicting energy consumption in smart grids. ANNs have shown the ability to capture complex patterns and nonlinear relationships in historical energy consumption data, making them ideal for accurate load forecasting. NB, RF, and DT are also effective in forecasting energy demand by handling complex data and reducing redundancy [6].

The integration of IoT and machine learning technologies provides a comprehensive approach to real-time monitoring and predictive analytics, addressing the dynamic challenges of power distribution systems. This study contributes valuable insights into the relationships between IoT and machine learning, paving the way for the development of future-ready smart grids. By integrating advanced technologies, this research aims to ensure the reliability, efficiency, and sustainability of power systems in the evolving power grid environment. It serves as a roadmap for a resilient, adaptive, and sustainable future in energy management.

2 METHODOLOGY

2.1 *Working of the proposed system*

This project intended to provide an Iot based smart system for advance power demand prediction at the distribution substation within real-time various devices embedded with voltage, current, power quality, smart meters,Phasor measuring units (PMUs). These sensors at that point consistently screen the force utilization of the charger, The information is additionally investigated and put away by a microcontroller. While current sensors monitor the flow of electricity, voltage sensors maintain the quality of electrical supply. PMUs give insight into system-wide dynamics while smart meters observe power use at the consumer level. Power quality sensors can detect voltage sags, swells, and harmonics on an ongoing basis. Real time data is send to the microcontroller for further analysis. Using this data to train machine learning models, we can model the capacity in which power storage is discharged at a later point, and with an efficiency of 80%+, we can predict future power needs with a high degree of accuracy based on past consumption patterns. The prediction capability is essential for the effective allocation of resources, and it enables proactive decisions in the smart grid environment, which is ever-changing. It combines IoT with machine learning to increase demand prediction accuracy, so grid operators can then have the data they need to troubleshoot and energy plans. Design of the exoskeleton is shown in Figure 1.

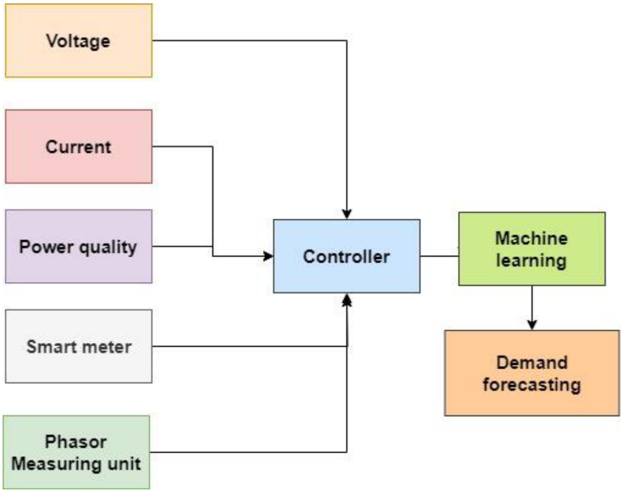

Figure 1. Design of the exoskeleton.

2.2 *Various sensor used in this research*

The research enables real-time monitoring and power consumption prediction at distribution stations by using a broad variety of sensors and a sophisticated array of IoT devices. Current sensors are an essential part of the system because they accurately track the flow of electric current in the grid. These sensors make it possible to assess power consumption at various distribution points, which is vital information on the dynamic nature of energy demand. Voltage sensors are used in parallel to monitor voltage levels and ensure the stability and reliability of the power supply. By continuously assessing the power quality using power quality sensors, the system can identify and address issues such as harmonics, voltage sags, and swells, guaranteeing a high-quality power supply. Coordination of measurements of the voltage and current phasors is made possible by Phasor Measurement Units (PMUs), contributing to a deeper understanding of the power system's dynamic behaviour. Smart meters are essential components of granular energy consumption monitoring systems when they are integrated at the consumer level. Real-time data is provided by these devices, which is crucial for demand-responsive and energy-saving initiatives. Resource allocation is thus more precise and efficient. The integration of these many sensors led to the construction of a full Internet of Things infrastructure, which supports the research's data collection system.This intricate network of sensors continually gathers real-time data, which is then sent to a microcontroller for processing and storing. Based on collected data, machine learning algorithms provide accurate predictions of future power use. Combining these Internet of Things (IoT) devices and technologies not only improves power monitoring in distribution stations but also promotes smart grid technology research and produces more robust, adaptable, and sustainable energy management systems.

2.3 *Various machine learning approach*

The study explores the prediction of energy usage in smart grids using machine learning methods such as Artificial Neural Networks, Naive Bayes, Random Forest, and Decision Trees. Artificial Neural Networks analyse historical energy consumption data to model complex patterns and relationships. Naive Bayes simplifies calculations by assuming independence of conditions. Random Forest builds multiple decision trees to improve predictive accuracy, especially in high-dimensional data. Decision Trees separate input components to create a tree model for accurate energy demand forecasts. These machine learning methods enhance load forecasting in smart grids for resource optimization and power management, providing insights into dynamic energy usage patterns.

3 RESULT AN DISCUSSION

In order to collect real-time data for the load forecasting experiment at hourly intervals, a number of sensors were thoughtfully positioned across the smart grid. These sensors included power quality sensors, voltage sensors, current sensors, phasor measuring units, and smart meters. The obtained data included many elements, such as voltage levels (measured in volts), current flow (measured in amperes), phasor measurements (measured in radians), power quality indices, smart meter readings (measured in kilowatt-hours), and the associated energy consumption (measured in kilowatts). The experiment's objective was to create a dynamic scenario that would faithfully replicate the features of an actual smart grid while taking daily fluctuations in power use into consideration. Thirty measurements taken throughout the experiment are summarized in Table 1, which also demonstrates the intricate link between the various sensor readings and the corresponding power consumption. For instance, the phasor measurements provide a more thorough image of the dynamic behaviour of the power system, whilst the recorded voltage and current values offer information on the stability and intensity of power flow. Power quality indices evaluate the stability of the electrical supply, while consumer-level data from smart meters facilitates a more thorough analysis of power use trends. Instantaneous power demands, or recorded demand numbers, are used to train machine learning models. Taking everything into account, Table 1 offers an overview of the large dataset generated during the experiment, laying the groundwork for future studies and the application of machine learning techniques to load forecasting in smart grid applications. Figures 2, 3 and 4 shows the sensor reading and the demand obtained from the IoT system. It is seen that as the sensor reading increases the demand also increases which shows the reliability of the sensor readings.

Table 1. Sensor readings and demand.

Hour	Current (A)	Voltage (V)	Phasor (Radians)	Power Quality Index	Smart Meter Reading (kWh)	Demand (kW)
1	50.2	230.5	0.75	0.92	120.5	45.2
2	48.7	229.8	0.82	0.88	125.2	42.8
3	51.3	231.2	0.78	0.91	130.1	44.6
4	49.8	230.9	0.79	0.89	135.3	41.5
5	47.5	229.4	0.76	0.93	140.6	43.2
6	53.1	232.7	0.80	0.87	145.8	46.9
7	50.6	230.3	0.77	0.90	150.2	45.7
8	48.9	229.6	0.81	0.88	155.4	42.3
9	52.4	231.9	0.75	0.92	160.7	44.8
10	49.1	230.4	0.78	0.91	165.9	41.9
11	47.8	229.7	0.83	0.87	170.3	43.5
12	50.3	230.1	0.79	0.90	175.5	46.2
13	48.6	230.8	0.76	0.93	180.8	45.0
14	51.2	231.3	0.82	0.88	185.2	42.7
15	49.7	230.6	0.77	0.91	190.4	44.5
16	47.4	229.9	0.80	0.89	195.7	41.4
17	53.0	232.2	0.78	0.92	200.9	43.1
18	50.5	231.5	0.75	0.91	205.3	46.8
19	48.8	230.2	0.83	0.88	210.5	45.6
20	51.4	232.6	0.79	0.90	215.8	42.2

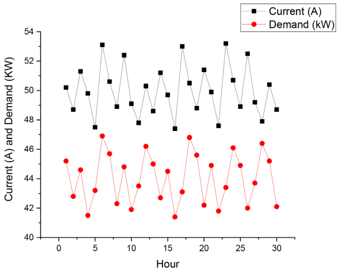

Figure 2. Current and demand measured.

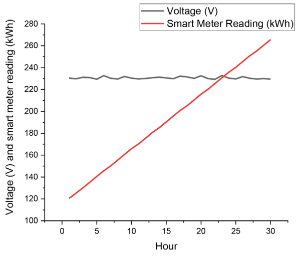

Figure 3. Power quality and phasor.

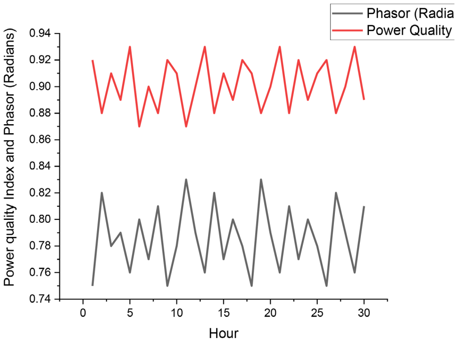

Figure 4. Voltage and smart meter reading.

4 CONCLUSION

The presented research successfully addresses the critical challenge of real-time power consumption prediction in distribution stations through the integration of advanced Internet of Things (IoT) systems and machine learning techniques. The comprehensive architecture, encompassing a diverse array of sensors such as current sensors, voltage sensors, power quality sensors, PMUs, and smart meters, provides a holistic approach to monitoring and analysing power usage. The machine learning models employed, including Artificial Neural Networks (ANN), Naive Bayes (NB), Random Forest (RF), and Decision Trees (DT), contribute to accurate load forecasting. The utilization of ANN, with its ability to uncover intricate patterns and adapt to dynamic load fluctuations, enhances the precision and adaptability of power consumption predictions. Naive Bayes, despite its simplified assumption of feature independence, proves effective in probabilistic load forecasting, particularly in handling high-dimensional data. The integration of Random Forest, as a powerful ensemble technique, further bolsters the research's forecasting capabilities by managing complex, multi-dimensional data and reducing the likelihood of overfitting. Decision Trees, both independently and as part of ensemble learning, offer interpretability and clarity in understanding the factors influencing energy use, making them valuable tools in the predictive modelling process. The results and discussion section presents a meticulous examination of the real-time data collected through the deployed sensors, demonstrating a strong correlation between sensor readings and power consumption. The intricate relationship between current, voltage, phasor measurements, power quality indices, smart meter readings, and energy demand is well-documented in the provided dataset, establishing a foundation for future studies and the application of machine learning techniques in smart grid applications.

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COVID-19 prediction classification models comparison by patient's symptoms and medical history

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ABSTRACT: COVID-19 prediction models were developed by using the patient's symptoms and medical history as input data and comparison of classification models is done. Decision Tree (DT) and Random Forest (RF) models are the most accurate machine learning classification models among all the classifiers used for this type of dataset giving the accuracy of 98.5 percent. Gaussian Naïve Bayes and Logistic Regression are not very accurate models for predicting COVID-19 cases based on symptoms and medical histories. Breathing Problem, Sore Throat, Dry cough and fever are the most important symptoms to predict whether the patient is having the COVID-19 infection or not. Also, in all these symptoms Breathing Problem has the highest weightage.

Keywords: Machine Learning, Classification Models, Supervised learning, COVID-19 Prediction, COVID-19 Symptoms

1 INTRODUCTION

The COVID-19 disease started in 2019 and became a global pandemic shortly [1]. Lot of people had to undergo real-time reverse transcription polymerase chain reaction (RT-PCR) test to know are they having COVID-19 virus or not, so that the positive cases can be separated from the general population to stop the spread of the pandemic [2–4]. This was a mammoth task, and it posted a lot of burden on the health department [5]. So, a quick and efficient approach is needed to get the test results quickly. This was solved by the machine learning approaches to predict the COVID-19 positive cases based on the input parameters given.

The process of predicting the class of the output value based on the input features is called the classification techniques [6]. Machine Learning (ML) algorithms in general can be done using two ways: supervised and unsupervised learning. Supervised learning is again of two types: classification model and regression model [7]. The various type of classification models developed in ML are Support Vector Machines (SVM), Decision Tree (DT), Random Forest (RF), Gaussian Naïve Bayes (NB), Logistic regression (LR), K-Nearest Neighbor (KNN) etc. [8].

The data collected in supervised learning process is labeled data this labeled data is divided for training and testing purposes to develop the classification model [9]. At First, the model is trained by providing labeled training data then this trained model is ready for testing and is tested before using for prediction on the test data which is also labeled but this time labels are used to check the accuracy of the model by verifying the predicted output label with the original label of the data [10].

The objective of this study is to predict the COVID-19 positive case by using different symptoms and medical statistics of a patient as input. To Develop a model with the help of the dataset and then check the accuracy of different classifiers available and compare their accuracy. Also, from the various symptoms and medical stats find out the most important feature for the prediction of COVID-19 infection.

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2 LITERATURE SURVEY

Lot of models were proposed to effectively manage this testing phase globally. A model was proposed by Zoabi *et al.* to predict positive cases of COVID-19 through RT-PCR test by giving answers of eight basic questions based on Machine learning [11]. In one more such method by Sun *et al.*, four types of machine learning classification techniques were used namely logistic regression, support vector machine, decision tree, random forest, and a deep learning-based model for early detection of COVID-19 and in this study LR model was proven the best [12]. In one more study by Zhou *et al.* a clinical score was developed to predict severity of COVID-19 disease based on the input parameters of age, gender, medical records, and lab examination results. In this method 4442 patient's data was used, and a clinical score was given to each person [13]. According to Ali *et al.* shortness of breath, dry cough, and high fever were noted as common symptoms observed in most of the COVID-19 cases [14].

3 METHODOLOGY

Dataset used in the paper was downloaded from Kaggle website's dataset section (https://www.kaggle.com), which was given by the name 'COVID-19 (Symptoms of the disease)'. Patient's medical history, symptom and status was given in the data and the main goal of the data was to build a classification model to detect whether the patient had COVID-19 disease or not.

First, the CSV file of the data was downloaded from the Kaggle website. The dataset was uploaded to Google Colab and a python code was developed for Exploratory Data Analysis (EDA). After the primary information about the data was achieved the data pre-processing was done followed by the data visualization.

Then data splitting is done for training and testing. 80 percent of the labeled data was given to training and 20 percent was used for testing the accuracy of the model. After that data was standardized. Then all the machine learning classification models were checked on the testing data for accuracy starting with Logistic Regression (LR) model. The predicted result's accuracy and error was calculated for all the classification techniques one by one. Same process was followed for SVM, Decision Tree, Random Forest, Gaussian NB and KNN respectively.

After that Each model's performance visualization was done and the performances of all the models were compared with each other. Finally, the Feature importance factor was calculated for each parameter. As there were 13 parameters so feature importance was calculated for all 13 parameters.

4 RESULTS

By doing Exploratory Data Analysis (EDA) on the dataset in Google colab using python code we get the information that the dataset contains 5434 instances, and it had 14 data columns. Details regarding these 14 columns is given in Table 1.

Table 1. Dataset features information.

Column No.	Feature	Instances/Null values
1	Breathing Problem	5434/no
2	Fever	5434/no
3	Dry Cough	5434/no
4	Sore throat	5434/no
5	Running Nose	5434/no
6	Asthma	5434/no
7	Chronic Lung Disease	5434/no
8	Headache	5434/no

(*continued*)

Table 1. Continued

Column No.	Feature	Instances/Null values
9	Heart Disease	5434/no
10	Diabetes	5434/no
11	Hypertension	5434/no
12	Fatigue	5434/no
13	Gastrointestinal	5434/no
14	COVID-19	5434/ no

So, the size of the dataset is (5434,14). The 14th column in the dataset is used for prediction of whether the COVID-19 test is positive or not. According to the result of RT-PCR test, data is classified as yes, or no means COVID-19 test was positive or negative. As shown in the Figure 1 how the two classes were labeled in the dataset, the 'Yes' cases of COVID-19 are more in the data then the 'No' cases. Almost 8 out 10 cases are of 'Yes' and only two out of 10 cases are of 'No' in case of COVID-19 feature data.

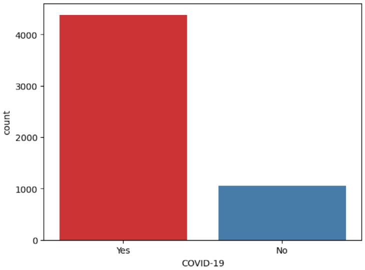

Figure 1. COVID-19 feature of the dataset on which prediction and training of models will be done.

Figure 2 shows the data distributions of other parameters, all the parameters have two classes and no null entries as shown.

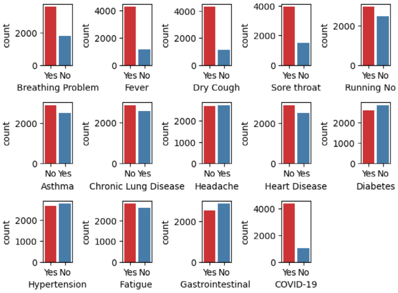

Figure 2. Instances representation of other parameters.

Figure 3 shows the correlation heatmap of the different features, it shows how each feature is correlated with other feature. The darkest color cell means the highest + ve correlation between features and the lightest color (white) cell means the – ve correlation of the feature. + ve correlation means when one increases the value of other also increases with the given factor written in the cell, similarly – ve correlation means when one increases the other feature decreases with the value mentioned in the cell. Highest value of +ve correlation is 1 and of – ve correlation is -0.2 given in the Figure 3.

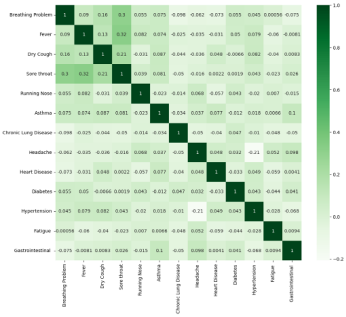

Figure 3. Correlation heatmap of features.

Performance accuracy of the different classification techniques used on the dataset is given in the Table 2, As shown Decision Tree and Random Forest model are the most accurate models having the accuracy of 98.528059 % and after that second highest accuracy is of the KNN method which is 97.424103 % after that there is SVM with 96.412144 % accuracy and Logistic regression with 91.260350 % accuracy. Gaussian NB method has the lowest accuracy for this type of dataset.

Table 2. Accuracy of classification models.

Sno.	Classification Model	Accuracy (in %)
1	Logistic Regression	91.260350
2	SVM	96.412144
3	Decision Tree	98.528059
4	Random Forest	98.528059
5	Naïve Bayes	88.408464
6	KNN	97.424103

Figure 4 shows the bar plot representation of performance accuracy of the different classification models. As shown Decision Tree and Random Forrest has the highest accuracy and Gaussian NB has the lowest accuracy.

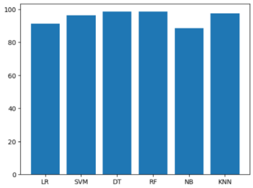

Figure 4. Performance visualization of classification models.

Table 3 shows the important features for predicting the Covid-19 outcome. As shown Breathing problem, Sore throat and Dry cough is the highly important features or symptom out of the all others features to predict Covid-19 outcome. Importance of Breathing Problem, sore throat and Dry cough is almost 20 % of the total data. Diabetes is the lowest important feature for prediction of COVID-19 outcome as per the study.

Table 3. Feature importance in COVID-19 prediction.

Sno.	Feature	Importance
1	Breathing Problem	0.196471
2	Sore Throat	0.185987
3	Dry Cough	0.181797
4	Fever	0.098240
5	Running Nose	0.039363
6	Gastrointestinal	0.038851
7	Headache	0.038751
8	Asthma	0.038620
9	Hypertension	0.038112
10	Chronic Lung Disease	0.037735
11	Heart Disease	0.036956
12	Fatigue	0.035871
13	Diabetes	0.033246

5 DISCUSSION

According to the results Decision Tree and Random Forest Models are 98.53 % accurate for prediction of COVID-19 detection based on the symptoms and medical history of the patient. Gaussian NB and Logistic regression are the least accurate methods to use for this type of dataset.

Breathing Problem, Sore Throat and Dry cough are the most important features and symptoms in a patient for prediction of COVID-19 positive or not. Similarly, as per results Diabetes, Fatigue, Heart Disease, Chronic Lung Disease, Asthma, Headache, Gastrointestinal and running nose are the least important parameters or symptoms for predicting whether a patient is having COVID-19 infection or not.

As we can see from Figure 3 breathing Problem, and fever have a positive correlation with the sore throat and have 0.3 correlation coefficient. It means if sore throat increases breathing problem and fever also increases by the factor of 0.3. Headache and hypertension are negatively correlated with correlation factor -0.21. This means if headache increases by 100% hypertension decreases by 20 % and vice versa. Dry cough and sore throat are positively correlated by 0.21 correlation factor. Chronic Lung Disease, Headache, Heart Disease and Gastrointestinal are negatively correlated to Breathing problem by -0.098, -0.062, -0.073, -0.075 respectively.

6 CONCLUSION

Decision Tree (DT) and Random Forest (RF) models are 98.5 % accurate in classifying among the 6 basic classifiers namely LR, SVM, DT, RF NB and KNN used in predicting whether patient is suffering from COVID-19 infection or not. The inputs given to do the prediction are symptoms patients is having, status and the medical history of the patient. Gaussian Naïve Bayes and Logistic Regression are not very accurate models for predicting COVID-19 positive cases based on symptoms and medical histories. This dataset can also be checked for the performance and accuracy analysis of Neural Network for this type of prediction and its performance can also be compared with the other ML Techniques used in this paper. This can be done in the future as the next stage of this study.

Breathing Problem, Sore Throat, Dry cough and at last fever are the most important symptoms to predict whether the patient is having COVID-19 or not. Also, in all these symptoms Breathing Problem has the highest weightage. As given in Table 3 if the patient is having Breathing problem than it is 20 percent sure that he may be suffering from COVID-19 infection. Similarly, if patient the is having sore throat and dry cough than it is around 18 percent sure that he will have Covid-19 infection. In case of fever, it is almost 10 percent certain that the patient will have COVID-19 infection. This feature importance part of this study can be applied to other diseases and other tasks of predictions also, where you can know by which certain parameters you will be able to predict the results easily. So only a certain input features will be taken, and which input features are important can be calculated through this above proposed method.

If sore throat increases breathing problem will also increases by the factor of 0.3 as both have positive correlation as calculated by this study. Cause of sore throat can be physical and environmental factors also, like airborne pollution, smoking, air conditioning these factors also have a great weightage as a cause for the sore throat [15]. By this study we have a prove that breathing problem and sore throat have a correlation, the same results can be observed by heat map of the data also to see a generalized relation between two parameters. Similarly, sore throat increases fever also increases by factor of 0.3. Few of the features like Headache and hypertension are negatively correlated by a factor of -0.21. Which means if headache increases hypertension decreases with a factor of 0.21. which was very easily interpreted by the method of this study without any extra data. Similarly lot more effective correlation and anticorrelation can be easily observed from the heat map given in the Figure 3 like Dry cough and sore throat are positively correlated. Chronic Lung Disease, Headache, Heart Disease and Gastrointestinal are negatively correlated to Breathing problem. This type of approach can also be applied to other disease to see the correlation and anticorrelation of factors responsible for that disease. So that the patient will have an extra information for prevention, monitoring, and control of the diseases. This method proposed can be used in other tasks also to find correlation and anticorrelations between any features.

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Digitalized college management system

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ABSTRACT: The Digitalized College Management System (DCMS) transforms the academic and administrative landscape of higher education institutions. With its extensive feature set, DCMS improves academic quality, streamlines administrative processes, and encourages open communication between stakeholders. Administrators can access consolidated databases for effective management of student records, admissions, and financial transactions via its online interface. Simplified academic scheduling tools let faculty members create balanced programs and allocate resources more effectively. Additionally, students are empowered by the system's mobile application, which offers individualized portals that provide on-the-go access to course materials, progress monitoring, and peer and teacher discussion. Through the use of cutting-edge technology, DCMS guarantees decision-making and real-time data accessibility, encouraging effectiveness and responsibility at all institutional levels. Transparency and involvement are promoted by efficient channels of communication, such as email alerts and integrated messaging systems, which close the gap between parents, students, teachers, and administrators. Additionally, DCMS makes resource management easier by offering staff, equipment, and facility management capabilities, which promote teamwork and a positive learning environment. DCMS becomes a strategic necessity as higher education institutions embrace the digital era and aim to equip students for success in a constantly changing global environment. Colleges may become leaders in innovation and quality by optimizing operations, improving student results, and enhancing the entire educational experience through the use of digital and mobile technology.

Keywords: Applications for Android & Web

1 INTRODUCTION

The Digitalized College Management System (DCMS) presents itself as a revolutionary approach to enhance and streamline administrative functions in higher education establishments. Through the use of technology, DCMS transforms conventional management techniques and provides a smooth integration of web and mobile platforms to improve academic experiences, expedite processes, and improve communication. Administrators can effectively handle student records, admissions, financial transactions, and academic scheduling with the help of DCMS's centralized databases, user-friendly tools, and real-time access to vital information. Faculty and students can also benefit from personalized portals that foster greater engagement and collaboration. DCMS facilitates smooth collaboration and informed decision-making by bridging the divide between administrators, instructors, students, and parents through user-friendly interfaces and strong communication channels. Additionally, DCMS enables institutions to maximize operational efficiency, improve academic quality, and create a supportive learning environment that fosters student success and achievement by optimizing resource allocation and employing data analytics. In order to lead schools into the future of education, DCMS becomes a strategic necessity as higher education institutions embrace the digital world. An increasingly complicated and interconnected world requires students to be prepared for success, and institutions may put themselves at the vanguard of educational excellence by embracing innovation, collaboration, and technology-driven solutions. Colleges may start a journey of transformation, empowering

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stakeholders, improving academic outcomes, and forming the leaders and innovators of tomorrow, with DCMS as the cornerstone of contemporary education management.

2 OBJECTIVE

The Digitalized College Management System (DCMS) is to streamline and enhance the administrative, academic, and communication processes within a college or university using digital technologies.

- Automating routine tasks such as student registration, course scheduling, grading, and attendance tracking to improve efficiency and reduce manual workload for administrative staff.
- Ensuring accuracy in data management and record-keeping, minimizing errors and discrepancies commonly found in manual systems.
- Providing stakeholders (students, faculty, staff, and parents) with easy access to information regarding courses, schedules, grades, and other relevant data, promoting transparency and accountability.
- Facilitating effective communication among stakeholders through features such as messaging systems, notifications, and online forums.
- Generating reports and analytics to help administrators make informed decisions regarding resource allocation, curriculum development, and student performance.
- Optimizing the utilization of resources such as classrooms, faculty members, and facilities through better planning and scheduling.
- Implementing robust security measures to protect sensitive data and ensure compliance with data protection regulations.
- Designing the system to accommodate the growing needs of the institution as it expands and evolves over time.
- Ensuring that the system is user-friendly and accessible to individuals with disabilities, as well as providing support for multiple devices and platforms.

3 PROPOSED SYSTEM

This paper concentrates on the performance and features of the proposed digitalized college management system (DCMS), which seeks to improve academic productivity and reduce administrative tasks in higher education. DCMS will streamline technology gets DCMS system to optimize resource placement, enhanced communication, and smooth process turnaround. This will allow the manipulation of information from multiple locations in a single place, helping with efficient management of student records, admission, financial transactions, and academic scheduling. Some examples include personalized faculty and student portals for easy access to course content, monitoring forms and interactions. The system shall be interoperable, unified and cloud-ready accessible through web and mobile platforms, ensuring transparency, collaboration and informed decision-making. Based on scaling, flexibility, and usability, customizable modules and settings will provide DCMS. These solutions can be data-driven decisions and operational efficiency through advanced analytics and reporting tools. These security mechanisms for connected data will also help retain consumer information securely and ensure all regulatory compliance are followed that users will be using. In summary, the school in DCMS will become an educational administrative revolution in favor of Clergymen of students and graduates.

4 MODULES DESCRIPTION

4.1 *Dashboard*

The Education Management System dashboard serves as a comprehensive tool for educators, administrators, and students alike, offering a centralized platform to streamline educational processes and enhance overall efficiency. Through intuitive design and user-friendly interfaces, the dashboard provides quick access to vital information, such as student performance metrics, course schedules, and administrative tasks. Administrators can efficiently manage resources, monitor academic progress, and generate insightful reports to support data-driven decision-making.

4.2 *Library management system*

The library module within an Education Management System is a fundamental component that empowers educational institutions to efficiently manage their academic resources. It serves as a digital repository for various learning materials, including textbooks, research papers, and multimedia resources, accessible to students and faculty members alike. Through advanced cataloging and search functionalities, users can easily locate and retrieve relevant materials, enhancing the overall learning experience and supporting academic endeavors. Furthermore, the library module facilitates seamless resource management, allowing librarians to track inventory, monitor borrowing activities, and manage subscriptions effectively. Integration with the EMS ensures synchronization of data, enabling real-time updates on available resources and loan statuses. By leveraging technology to streamline library operations, educational institutions can optimize resource utilization, improve accessibility, and cultivate a culture of lifelong learning within their academic community.

4.3 *Academic management system*

Academic Management System (AMS) serves as a comprehensive platform designed to streamline and optimize various administrative and academic processes within educational institutions. This system encompasses a wide range of functionalities, including student information management, course scheduling, grading, attendance tracking, and communication tools. One of the key features of an AMS is its ability to centralize student data, enabling administrators to efficiently manage enrollment, admissions, and student records. Through intuitive interfaces and customizable dashboards, educators can easily access student profiles, monitor academic progress, and generate reports to track performance metrics and identify areas for improvement. Furthermore, an AMS facilitates effective course management by automating scheduling, resource allocation, and curriculum planning. Educators can create and manage course materials, assignments, and assessments, while students can access course materials, submit assignments, and participate in online discussions through integrated learning management systems (LMS). Moreover, communication tools within an AMS enable seamless collaboration among students, faculty, and administrators. Features such as messaging systems, discussion forums, and announcements keep stakeholders informed and engaged, fostering a supportive learning environment. Overall, an Academic Management System enhances operational efficiency, improves communication, and supports data-driven decision-making, ultimately contributing to the success and advancement of educational institutions.

4.4 *User permissions*

Educational Management Systems (EMS) employ varied user roles: Administrators oversee system settings, faculty manage courses and grades, while students access personal academic records. Parents may view child-related data, librarians handle library resources, and admissions officers manage enrollment. Flexible permission systems ensure data security and compliance, needing periodic updates for organizational adaptability.

4.5 *Hostel management system*

A Hostel Management System streamlines student registration, room allocation, and check-in/out procedures. It efficiently manages room inventory, billing, and communication between administrators and residents. Through reporting and analytics, it offers insights into occupancy rates, revenue, and maintenance trends. Overall, it enhances the resident experience and ensures effective administration of hostel facilities in educational institutions and hospitality sectors.

4.6 *Learning management system*

An LMS simplifies educational content creation, delivery, and management, serving as a central hub for organizing courses and facilitating communication between instructors and learners. Its core functionalities include course management, content authoring, student enrollment, progress tracking, and reporting. With built-in authoring tools or integration options, instructors can create engaging content like videos, simulations, and interactive assessments. Administrators can enroll students, manage accounts, and track attendance, while also generating reports to monitor engagement and measure learning outcomes. Overall, an LMS optimizes the educational experience by providing a structured platform for effective teaching and learning.

5 CONCLUSION

The digitalized college management system represents a paradigm shift in the way educational institutions operate and manage their resources. By leveraging advanced technology and innovative features, this system streamlines administrative processes, enhances academic efficiency, and fosters transparent communication among stakeholders. From centralized databases to personalized portals, the system empowers administrators, faculty, students, and parents with real-time access to critical information, enabling informed decision-making and collaboration. Despite the challenges and complexities associated with implementation, the benefits of a digitalized college management system are undeniable, offering enhanced efficiency, improved communication, and data-driven decision-making. As educational institutions embrace the digital age, investing in and continually enhancing such systems becomes imperative to stay competitive, deliver quality education, and prepare students for success in an ever-changing world. By embracing innovation and adaptation, colleges can position themselves at the forefront of educational excellence, shaping the leaders and innovators of tomorrow.

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Lung cancer detection using Resnet architecture: Lung nodule detection in CT images

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ABSTRACT: This article proposes a novel technique to detect lung cancer from CT images that use deep residual learning. To identify areas of the lung that are at risk for cancer, we outline a series of pre-processing approaches. After the data is analyzed using classifiers such as XGBoost and Random Forest, it is integrated with other information to determine whether or not a CT scan is cancerous. 3D-SE-IRNet and 3D-SE-IRNet were created to increase network accuracy by making use of the 3D nature of CT scans and feature map channels. The test we did shows that CNNs are good at putting lung tumors on CT pictures into the right category. Self-mechanism and 3D convolution make the network much more accurate. Specificity, and sensitivity. This shows that the individual model is not as good as the Ensemble model. In addition to this, the E-ResNet-NRC model has improved generalization and resistance capabilities.

Keywords: Resnet, segmentation, lung, CSENet, 3D convolution. U-Net, SENet, 3D convolution

1 INTRODUCTION

The official periodical of the American Cancer Society, the Global Cancer Research Fund predicts that there will be 18.1 million new diagnoses of cancer and 9.6 million deaths from cancer in 2018 [1]. With modern medical technology, early detection and tailored therapy are still the best options for lung cancer treatment, and clinical data reveals [2] that treatment effectiveness is significantly connected with the stage of cancer in its diagnosis. Patients with this cancer [3] have a much lower survival rate and a significantly higher survival rate if it is diagnosed early. [4] Wang *et al.* proposed a method for detecting lung cancer from photos that is only moderately supervised. This method was originally used to preserve discriminative blocks and provide illustrated deep features at a high level of efficiency [5]. Using an integrated strategy, they combine Alex Net, Google Net, VGG, and ResNet deep neural networks. It is ResNet [6] that uses a residual module that links the initial input to the layer outputs directly, successfully addressing the network deterioration issue. Its simplicity and high performance have become ResNet the industry's most widely used CNN design, and it continues to provide the foundation for further research into CNN architecture. The ResNet concept is introduced into the inception module through Inception-ResNet [7]. ResNeXt [8] reduces the amount of parameters by using residual connections.

2 LITERATURE SURVEY

Classifying pixels into areas like bones and blood arteries might be useful in certain medical applications. A diseased location like cancer or tissue deformity is more suited in other applications [9] Segmenting medical images is a critical and indispensable part of the diagnostic process. These are the main steps used to find out if someone has lung cancer: The

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steps in the process are pre- processing of images, segmentation of images, extraction of features, and identification of lung cancer.Sergio Eduardo used template matching technology based on the anatomical properties of lungs to locate nodules [10,11]. Suggested to extract the suspicious nodes in the picture by utilising a combination of iris filtering, threshold segmentation, binary approach, and region expanding. The automatic solitary lung nodule method [12] preprocesses the original CT image using an adaptive iterative threshold approach. nodes in the picture by utilising a combination of iris filtering, threshold segmentation, binary approach, An innovative new three-dimensional lung nodule segmentation system has been suggested by Cascio *et al.* [13]. Figure 2 illustrates the method step-by-step. ZNet [14], Dense Net [15], ResNet [16], and other network architectures released subsequently, all of which are applied to lung nodes, are only a few examples of 2D image processing applied to the medical industry. The job of detecting sections [17] was successful, as shown by the positive detection outcomes.

3 METHODOLOGY

Convolutional neural networks (CNNs) have a tremendous capacity to extract and classify feature information from pictures, which benefits from their exceptional performance in visual pattern recognition. A non-linear activation function, we may create feature maps of this layer by combining several convolution filters that extract distinct characteristics from the image. Figure 1 shows the nodules located in human thorax.

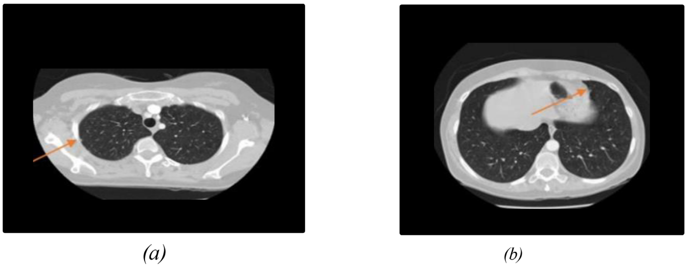
(a) *(b)*

Figure 1. Nodules located.

3.1 *Inception-ResNet*

Convolutional filters are replaced by several filters of varying sizes in the NIN (Network in Network) module, which captures visual characteristics at various scales. V2 includes BP (Batch Normalization) to overcome the vanishing gradient issue. Asymmetric convolution splitting, on the other hand, allows for a greater variety of patterns.

3.2 *Basic structure of CNN*

Conventional CNN design consists of a convolutional layer, a Rectified Linear Unit activation function, and pooling layers. High-level characteristics may be retrieved from low-level data using convolutional layers. To get these details, we utilise a lot of convolutional layers with a lot of depth. All of the image's details are well-represented. The ReLU layers aid in the transfer of important data to the next level. The network is given non-linearity as a result of this. ResNet is capable of training pictures with more than 50 layers. Table 1 provides the information of feature sets.

Table 1. Feature sets.

S.No.	Features
1	Energy
2	Entropy
3	Skewness
4	kurtosis
5	Average

3.3 *Image tiling and data augmentations*

The following slide is currently open: [18]. The WSI (*.scn) files containing raw pixels were accessed using the Python framework. The location, as well as the slide ID number, were saved for future reference. There were no unmarked regions utilised. Prior to image enhancement, tiles were displayed in Table 2 (see below).

Table 2. Image tiles.

Pixel size of the tile	295	501	751	1000	2000	2400	3000	4000	5000	10000
How big a tile is in microns	74	125	187	250	500	625	750	1000	1250	2500
About how many tiles there are	2,971k	1,001k	461k	293k	63k	35k	27k	15k	7.8k	1.3k

Voting was conducted on each tile forecast using this formula:

$$\widehat{\mathrm{Y}} = \mathrm{argmax}\Sigma_{j=1}^{N}\ \mathrm{w_j y_{ij}} \tag{1}$$

3.4 *Machine learning architecture*

The second stream of the proposed model is this machine learning architecture [19,20]. From both the spatial and frequency domains, the artificial characteristics are derived. Discrete Wavelet Transform Un-decimated Un-decimated Un-decimated (UDWT).

$$\mathrm{ENP} = \Sigma_{i=1}^{p}\mathrm{P}(\mathrm{Fv}(x,y)).\ \log(\mathrm{Fv}(x,y)) \tag{2}$$

$$\mathrm{EN} = 1\frac{1}{p2.q2}\Sigma_{X=1}^{P}\Sigma_{y=1\backslash}^{q}\mathrm{FV}(x,y)\backslash^{2} \tag{3}$$

$$\mathrm{AVG} = \frac{1}{p.q}\Sigma_{X=1}^{P}\Sigma_{y=1}^{q}\mathrm{FV}(x,y) \tag{4}$$

Because of the importance of avoiding regions near the lung, this step should be taken especially slowly to prevent missing anything. In order to remove the veiled lungs, seven steps have to be taken [22]. Finding Nodules in the Lungs is shown in Figure 2.

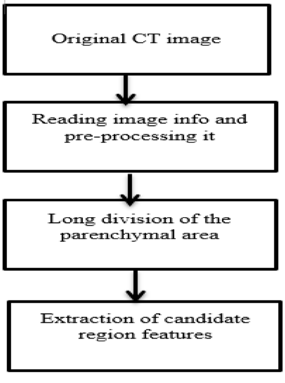
Original CT image
Reading image info and pre-processing it
Long division of the parenchymal area
Extraction of candidate region features

Figure 2. Finding nodules in the lungs.

4 RESULT & DISCUSSION

Deep neural networks are trained for 200 iterations using training data with a batch size of 32. Based on the data in

4.1 *Evaluation criteria*

Accuracy is measured by comparing the model's output to known information. This is known as the accuracy measurement indicator. Deep neural networks are trained for 200 iterations using training data with a batch size of 32. Based on the data in Table 3, it seems that the suggested technique is more accurate than the other methods under consideration. The convergence profile for cancer diagnostic accuracy

Table 3. The simulation results comparison.

Method	Accuracy	Sensitivity	Specificity	Error
This is the ResNet-18.	89.1	93.2	68.3	6.4
Search Engine Net	68.1	71.4	48.1	31.7
Google+ AlexNet	88.5	92.6	72.6	11.3
VGG-19	82.6	91.5	73.5	17.2

5 CONCLUSION

However, the fact that we used only lung malignancies that had been proved pathologically and pixel-level annotations by two radiologists in our dataset may lower the identification rate of benign nodules and masses. In most cases, this is not an issue in the clinical setting. It is technically possible to train all regions of the body except for the cancerous nodules/masses. However, in order to validate the model for extensive evaluation in clinical practise, normal photos should be blended in and examined. The suggested strategy may be put into action in three simple stages. There is a semi-automatic method for extracting the ground truth in each lung. As a result, this suggested model may be ideal for early identification of lung cancer. Raw data may be replaced in the future by feature-based input, which might improve network learning. This, in turn, might lead to significant increases in the network model's performance.

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Demystifying heart disease prediction: The role of iris imaging and explainable AI

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ABSTRACT: Iridology is a fairly new scientific discipline interested in the study of the beauty-contact areas of the body that are termed the iris. It can even assess problems with a variety of biological activities. Since the nervous system and brain connect the body's tissues and organs, the condition of each organ may be immediately revealed through the iris, and in this way, the cardia characteristics were retrieved through eye and feature expression and image pre-processing methods. In the system proposed, Explainable AI is now combined with machine learning techniques like K nearest neighbor and the random forest algorithm. If they unite, they will feel even stronger, more efficient, and self-reliant. With this component, estimating the probability of coronary artery disease becomes possible.

Keywords: Iris, Iridology, Coronary Artery disease, random forest, Image pre-processing & Explainable AI

1 INTRODUCTION

Each of the iris's most complicated tissue structures is the focus of iridology research. Through the analysis of iris patterns this method evaluates the state of the body' systems and organs. It can be applied to identify problems with many biological functions. The iris may be used to immediately assume the condition of each organ since the nervous system and brain connect the body's tissues and organs to the iris. To extract cardiovascular properties from the eye feature extraction and pre-processing were performed. In this system, Machine learning algorithm approaches Random Forest algorithm and KNN are used with Explainable AI.

2 LITERATURE REVIEW

One of the most prevalent illnesses in the modern world is cardiovascular disease (high-definition), that can be caused by a wide range of factors, such as overbearing blood sugar, type 2 diabetes,varying cholesterol, sleeplessness, and a number of others [Almustafa (2020)]. When it breaks down, our entire body may become polluted, and this illness typically results in death. Worldwide, here was a 41% increase in coronary artery disease from 1990 to 2013 [Awan *et al.* (2018)]. These factors include high blood pressure, gender, age, chest pain factor, and the Electrocardiogram (ECG), which measures heart function and is frequently utilized to build prediction models [Chen and Henigjinda (2021)]. High blood cholesterol levels that surpass optimal parameters a blood cholesterol level of less than 200 mg/dL is ideal can cause serious illnesses like strokes and heart attacks [Daniel *et al.* (2019)]. Image processing methods, particularly image segmentation, can be used to detect heart through the iris [Fadilla *et al.* (2022)]. This is because the most effective ways to lower the cardiovascular risk in

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people with symptomatic PAD revascularization or medication management included—remain little recognized [Jones *et al.* (2017)]. The viewpoints of medical studies and gathering data are applied to identify various metabolic disorders [Lakshmanarao *et al.* (2019)]. The multidimensional perceptron (MLP for short) mapping look at offers better precision up to 6.62%, while multiple linear regression increases AGSV, as per the results [Ozbilgin and Kurnaz (2022)]. Tests that include tests for blood, electrocardiogram (ECG), effort tests, Holter tests, and cardiograms (the organization) are often used to identify CAD technology [Özbilgin *et al.* (2023)]. In medical fields, improved picture processing and data mining methods are employed as an useful disease diagnostic tool [Sarnant and Agarwal (2018)]. In order to determine cases of autonomic damage to nerves based on iridology, more research utilizing neural networks that are artificial has been conducted [Yohannes *et al.* (2020)].

3 RESEARCH METHOD

3.1 *Iridescence*

Iridescence is the study which utilizes the human iris as a diagnostic apparatus. The iris is utilized in medicine to measure how well the human organs are functioning. Each of the 60 segments that make up iridology's segmentation the organ's status or operation is depicted by the eyeball. The functioning of the body's left organs is indicated by the state of their respective left iris, while the health of the right organs is shown by the status of the right iris. Figure 1 shows the display the intended system's flow.

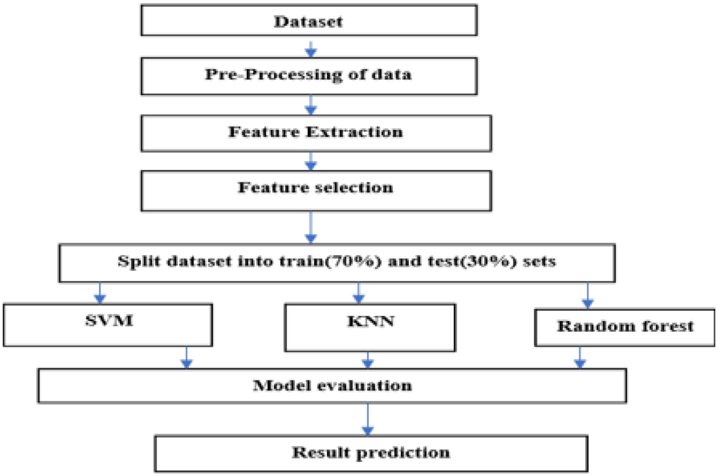

Figure 1. Display the intended system's flow.

3.2 *Load dataset*

Acquiring and arranging pertinent data for analysis is the process of loading the dataset in an iridology project. For the purpose of researching relationships between features of the eyes and medical disorders, the collection probably include iris photos or associated data. Essential stages involve monitoring data quality, cleansing the dataset, and accounting for factors including age, gender, and medical history. In the realm of iridology, this preliminary work establishes the framework for further investigation and pattern identification. Find an appropriate dataset's source. Typically, numerous types of analysis are conducted using distinct datasets for heart disease and Iris. Health related features are included in datasets for heart disease prediction, whereas the Iris dataset is frequently used for classification problems pertaining to iris emerge.

3.3 *Data preprocessing*

In ML loading dataset is the first step, then the data pre-processing refers to the methodical cleaning, modification, and arrangement of unprocessed data in order to get it ready for training a machine learning model. This is particularly relevant when predicting heart disease using the Iris dataset. Improving the quality of the data is the purpose of this process in order to make it suitable for efficient model training and prediction. In this pre-processing, managing missing values, encoding categorical variables, scaling features, and resolving any imbalance in the data are important processes. Using the features of the Iris dataset, the objective is to provide a new dataset that best supports the selected machine learning algorithm for precise and trustworthy heart disease prediction.

3.4 *Feature selection*

The goal of feature selection is to create graphs that, a machine learning algorithm used from the previously processed images. To use the Random Forest approach, features must be extracted from the pictures. Each vector value or phrase in the graph is counted on the quantity of times it appears. Feature selection can help the model perform better by reducing the number of dimensions in the iris.With the use of iris technology, certain characteristics pertaining to the iris's structure may be identified as potential heart disease indicators. Selecting iris features, common procedures involve determining which aspects are most connected with heart disease, removing less relevant ones, and assessing the statistical significance of each feature. This procedure contributes to the development of a more precise and effective model for iris-based heart disease prediction.

3.5 *Normalization*

The iris dataset can be used to predict heart disease, while normalization is necessary for machine learning models to produce effective predictions. The model's performance may be enhanced by ensuring that all features have a comparable scale. If iris technology is used to predict cardiac disease, the process of normalizing the iris data to a standard range is called normalization. Due merely to their greater size, certain variables are thus prevented from controlling the prediction model. On the other hand, it ensures that the various elements, such patterns or dimensions, gathered from iris scans are consistent in size.

3.6 *Region of interest*

To diagnose the heart through the iris, some elements are required; therefore, processing the complete image is not required. By using iridescence, the left-hand portion of the iris's cardiac projection can be observed in the area between 02.00 and 03:15. In the Region of Interest (ROI) technique, only a portion of the photograph needs to be processed. The image of the heart reflected by the left eye's iris stays after all of these parts have been eliminated used to support labelled examples into the model, allowing it to learn patterns and relationships (Figure 2).

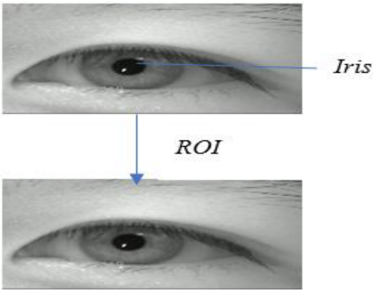

Figure 2. ROI of the iris.

3.7 *Training and testing*

On average, the iris dataset is utilized for developing a machine learning model which utilizes training and testing data to predict cardiovascular disease. The training data is unseen circumstances will be predicted in order to assess the model's effectiveness and see how well it generalizes to new data.

4 PROPOSED METHODOLOGY MACHINE LEARNING MODELS

Making use of many different machine learning approaches, such as randomized forest computing and k least cousins. Train the models on the pre-processed dataset to learn patterns indicative of heart disease. Common split ratios are 80-20 or 70-30 for training and testing.

4.1 *KNN (K-Nearest Neighbor)*

Regression and classification issues are handled utilizing a k-nearest-neighbors model (KNN), a supervised machine learning technique. When presented with a fresh input for classification, KNN finds the K training set data points that are closest to it using a selected distance metric (usually Euclidean distance). The new instance's class is determined by the majority class among these neighbors KNN (Figure 3) to estimates the target value in regression by averages, and assuming a weighted mean of the values of the closest K neighbors. The selection of K and the distance metric influence the algorithm's performance and vulnerability to exceptions.

$$\text{Accuracy} = \frac{\text{Total Number of Predictions}}{\mathit{Number\ of\ Correct\ Prediction} \times 100\%} \tag{1}$$

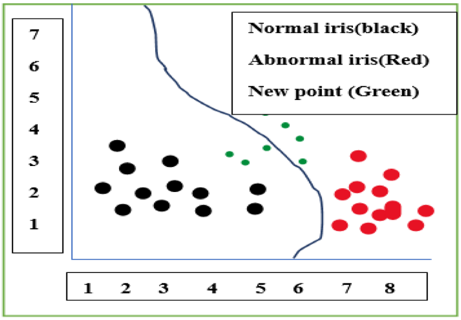

Figure 3. K-Nearest Neighbor.

4.2 *Random forest algorithm*

Random woodland learning is a prominent machine learning technique used in the controlled learning method. It can be employed in both the classification and regression challenges in machine learning. Integrating a number of classifiers to improve the model's accuracy and answer a complex issue has been referred to as combined learning, and it forms the core of this method. Between the ensemble learning techniques that are frequently used to predict heart disease using the iris dataset is the random forest algorithm. The approach is widely recognized for being able to process complex data and generate accurate forecasts. For each choice tree in the forest, a randomly selected portion of the features and data is used for training, and the mean of the dataset's inputs yields the final prediction. Applying the randomized forest method, this precision score contributes in our approximation of cardiopulmonary diagnosis. This accuracy track helps us expect the heart diseases by roughly 0.81 while we use a random forest proximity (Figure 4).

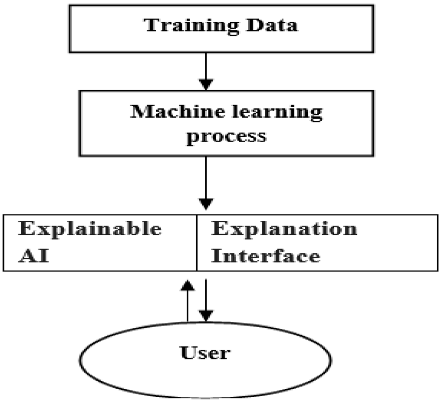

Figure 4. Explainable AI.

4.3 *Model evaluation*

Various measurements are utilized to assess the efficacy of the KNN model, including accuracy, precision, or recall. Enhancing the model's performance can be achieved through modifying the model's hyper parameters or employing a different type of feature selection.

$$\mathrm{F1score} = \frac{2 \times \mathrm{Precision} + \mathrm{Recall}}{\mathrm{Precision} \times \mathrm{Recall}} \tag{2}$$

4.4 *XAI*

Enhancing the transparency and clarity of the model's decision-making process refers to Explainable AI. Both the Random Forest and k-Nearest Neighbors (KNN) algorithms possess some level of explainability. KNN, a non-parametric with slow learning capabilities categorizes items based on the majority opinion of their closest neighbors, assigning them to the most prevalent group. The explainable aspect of KNN stems from its straightforward approach, which bases a data point's outcome on the classifications of its nearest neighbors. Therefore, to facilitate decision-making in the classification process, it is essential to identify and exhibit the closest neighbors along with their associated labels. Therefore, to initiate the decision-making phase in classification, it is crucial to recognize and showcase the nearest neighbors along with their associated labels. To illustrate the Random Forest decision-making process, one must consider the role of each feature in the classification procedure. Typically, the reduction of impurity is proportionate to the contribution of a specific feature. While both Random Forest and KNN provide some level of explanation, the manner in which their decisions are clarified varies. Random Forest relies on assessing feature importance, whereas KNN's explanation is more straightforward, relying on the classification of nearest neighbors.

5 RESULT AND ANALYSIS

In the iris dataset, the random forest method and K-nearest neighbors (KNN) are applied to predict heart disease. The performance of the models, which includes accuracy, precision, and recall, is evaluated based on the results. The random forest algorithm involves a collection of selected trees that yield accurate forecasts, while KNN depends on the nearby majority class. The analysis consists of evaluating the strengths and weaknesses of the models, identifying significant features that impact predictions, and comparing the effectiveness of random forest and KNN in predicting heart disease using the iris dataset. This is achieved through the use of Explainable AI for clear interpretation.

6 CONCLUSION AND FUTURE WORK

To sum up, the use of random forest and K-nearest neighbors (KNN) alongside the iris dataset offers valuable insights into predicting cardiac disease. Both models demonstrate strengths in heart disease prediction, with random forest providing robustness through ensembles and KNN relying on proximity for classification. The selection between the two models depends on specific needs, and further adjustments could improve predictive accuracy. Furthermore, the use of Explainable AI methods enhances model interpretability, highlighting the crucial features influencing predictions. This study sets a strong foundation for informed decision-making when applying machine learning methods to forecast heart disease. Future research exploring various organs, such as brain tumors and kidney deficiencies, holds significant potential for advancements.

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Diagnosis of autism spectrum disorder using deep learning with natural language processing

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ABSTRACT: The proposed research aims at enhancing the domain of ASD diagnostic by utilizing machine learning tools including, Decision Trees, Support Vector Machines (SVM), Artificial Neural Networks (ANN), and Recurrent Neural Network (RNN). We built upon a diverse dataset of 47,500 entries from medical records and reports, doctor's notes, clinical assessments as well as various sources on the web. The current work underscores this unique genealogy. Overall, by adhering to a more tedious 70–30 training-testing breakdown, we engender our models with robust integrity safeguarding against overfitting and allowing for more practical testing of model performance. In this way the research continues, with a range of feature extraction methods Bag-of-Words, TF-IDF, word embeddings sentiment analysis and topic modeling for example that allow the rich structures in text to be summarized into meaningful patterns. We train our machine learning models and also evaluate them based on the accuracy, precision, recall and F1 Score metrics. DT provides interpretability, SVM is particularly well-suited to high-dimensional problems, ANN can model complex patterns and RNN is capable of handling the time dimension. By breaking down true positives, true negatives, false positives and false negatives in the confusion matrices on a granularity level we can clearly identify where our models excel well in and where they need more work. These results highlight the importance of considering a complete perspective knowing, which are those context nuances that make selecting the ideal model for ASD diagnosis different. Here, we report our work to definitively justify the ongoing discussion surrounding early ASD detection by presenting some strong model capable results from a wide variety of ML models.

Keywords: Autism Spectrum Disorder, Machine Learning, Natural Language Processing, Early Diagnosis, Healthcare Technology

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1 INTRODUCTION

ASD is a multifaceted neurodevelopmental disorder manifested by problems in social interaction, communication as well as repetitive actions Diagnosis and intervention at the right time can effectively improve outcomes and quality of life for children on the ASD spectrum [1,2]. More recently, the intersection of natural language processing (NLP) with machine learning and deep learning in particular has shown great promise for extending the diagnostic capacity of these systems. In this study, we attempt to assess the feasibility of using machine learning models such as DT's, Support Vector Machines (SVM), Artificial Neural Networks (ANN) and RNNs in autism diagnosis according to textual summarization from different data types(e.g., medical records, clinical questionnaires,test reports, forum discussion) [3,4]. The surrounding ASD diagnosis has traditionally been made with the help of clinical assessments, behavioral observations and some standardized questionnaires. Although these are vital methods, scalability concerns and potential human subjectivity and required expert interpretation have encouraged the pursuit of alternative approaches. The integration of semantics also helps augment traditional diagnostic methods with machine learning techniques, taking advantage of the large amount of unstructured data available as textual information [2,5]. Machine learning in healthcare has been the topic of thousands of publications and more research groups' attention is going to health and medical conditions such as mental disorders, among them ASD. As a major class of interpretable model, DTs have been used to learn patterns from clinical data, helping in the recognition of vital predictive features characterizing ASD. Support vector machines have been successful in dealing with high dimensional data and they could distinguished ASD cases on the basis of all different features extracted from textual narratives [6,7]. However, ANN offer a powerful approach to capturing complex patterns from unstructured data. Most importantly, previous research has shown that ANNs are capable to learn complex relations within textual information. This is exactly what adds the discriminant power when it comes to an accurate diagnosis of ASD. In addition, RNN, which are geared towards sequential information processing, have been suggested as a potential approach to account for temporal dependencies inherent in stories — an important consideration both for medical records over time and Internet-based [8,9]. Wrapping up with this — other than option c which are nlp techniques like Bag-of-Words and Tf-Idf, have been used the most for text data preprocessing to make it fit into machine learning models These methods enable to extract pertinent features which can convert unstructured text to structured information and then further this flow can be fed into models for training and inference. In addition, sentiment analysis could be used to identify more subtle emotional attitudes expressed in text drawing a closer analogy with subjective experience associated with individuals during the Autism Spectrum Disorder.References to multiple sources including medical records, doctor's notes, clinical assessments and online forums are taken up by the dataset used for this research. Having diverse data sources enriching the feature space provides a more complete characterization of linguistic patterns in association with ASD. Though challenges linked to data privacy and ethical concerns continue, progress in anonymization and secure data management protocols is attempting to overcome them [10–12]. The application of these techniques in ASD diagnosis show great promise with progression and sophistication of machine learning models. It is complementary to the traditional way of diagnosing by being able to ingest and process large amounts of text, find complex patterns or red flags offering an objective view. In this research, we expand the body of knowledge at the intersection of machine learning, natural language processing and ASD diagnosis by conducting a detailed examination of the literature as presented below. The following sections, which included the Methodology, results and discussion, provide a complete tour through the study's findings along with their relevance to ASD diagnostics in future.

2 METHODOLOGY

Autism spectrum disorder (ASD) is a neurodevelopmental disorder marked by problems with social interactions, communication, and repetitive behaviors. Early intervention and support is key to enabling enhanced outcomes through timely diagnosis. How do you know if someone has CTE? It involves detailed history, clinical examination and even a pathology report. behavioral therapy that focuses on early intervention can help to improve social skills and minimize risk. That research on early-onset ASD has been done using machine learning in the form of deep learning and natural language processing. A dataset of 47,500 items enhances the language learning related to ASD from medical records, clinical assessments and online sources. *Build a machine learning model to be trained on labeled data, the application of which can predict ASD diagnosis with high accuracy The objective is to move the needle on ASD diagnosis using data driven methodology with a fusion of deep learning + natural language processing for identifying minute language cues that can result in early interventions and positive therapeutic outcomes. “It proposed that the high fluorescence of plasma samples could be used a novel approach which is applicable for healthcare professionals to promote early detection and assist in improving the life quality of ASD patients”. Figure 1 shows the methodology of the research.

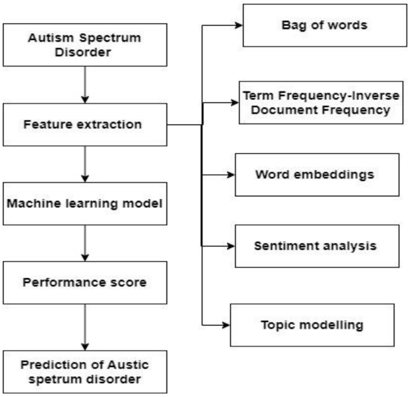

Figure 1. Methodology of the research.

3 FEATURE EXTRACTION MODEL

We can use machine learning to help diagnose ASD, by pulling out different characteristics from various datasets (e.g., medical records). “Technique like Bag-of-Words and TF-IDF that help to convert the text into machine understandable format, here we will come to know which are some of the crucial words for ASD majorly.” While text embedding gives us an idea of semantic relationships, sentiment analysis allows to get the emotional tone and topic modeling shows what it was all about. Combining these techniques allows for natural language based analysis which can increase the accuracy of ASD detection.

4 MACHINE LEARNING MODEL

In the current research work, machine learning methods (SVM, DT, RF and NB) were used to predict vector-based diseases. An SVM will learn intricate patterns, a DT will visualize hierarchical relationships and grow a tree using inverse recursing, and an RF would increase predictive power,, while Nai ve Bayes provides us with the probabilistic function that describes our data. Using all this together, accurately identifying specific diseases and individualized guiding patients to the right treatment path. Moreover, SVM was found useful for predicting disease over weather conditions and DT explained highest attributable risk factors of the disease. RF provided robustness, while NB provided probabilistic insights. The diagnosis of autism spectrum disorders used RNN, DT, ANN and SVM to complement each other's advantages to achieve accurate and efficient results through systematic analysis of all aspects.

5 RESULT AND DISCUSSION

Our research methodology distinguishes the areas of one dataset included in 70% used to train machine learning models and evaluate their performance forecasting Autism Spectrum Disorder within different linguistic contexts, while 30% are allocated for testing (Figure 2). This method provides strong estimates, helps to avoid over-fitting and generally strengthens the candidacy of our new diagnostic.

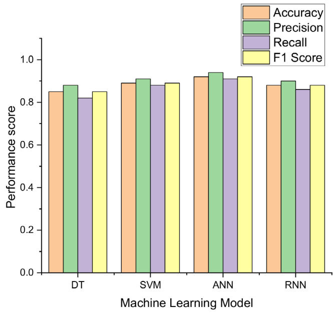

Figure 2. Performance score.

A general flow chart of different machine – A row for each combination of. specific study, machine learning model (DT = Decision Trees), precision, accuracy, recall and F1 score to evaluate different machine learning models (like DT, SVM, ANN and RNN) used in ASD diagnosis. Accuracy tells us how much ratio of right predictions has SVM done across the whole dataset. In this case it gives a 0.91 Accuracy. Recall is about our model's ability to find all of the positive samples, in this case was 0.91 for ANN the F1 score, combining precision and recall results a value to evaluate the functionality of a model. In our case, RNN displays 0.88 which is very good for indicating the strength between precision_and_recall balance. For each model, confusion matrices are utilized to demonstrate what the modal does well, and poorly in terms of performance As an unusual, To be more detail, DT gave the proper prediction (more negative samples and abundant of positive cases) to 1,200 bad reviews and 1,050 good reviews but DT also predicted many filthy excellent review as awful review in returned (one hundred fifty very bad case). On the other hand, we see for SVM 1,070 correct positive predictions but it also classified incorrectly as good 80 bad ones. These matrices give us an in-depth insight into the predictive capabilities of the models and also tells how we can increase our accuracy diagnosing ASD. In conclusion, the presented study has shown how one can rely on various machine learning models to ensure early ASD detection.

6 CONCLUSION

By combining various models such as DT, Bolster Vector Machines, Manufactured Neural Systems and RNNs in this manner, we aimed to har-ness the complicated patterns inside these literary information from healing records, clinical appraisals along with web sources. The performance evaluation showed that the qualities of each show, through precision, accuracy, recall and F1 Scores illustrate a lot of nuances in their capability for handling many different complexities inherent in ASD diagnosis. DT demonstrates intuitiveness, SVM displays its efficiency with high-dimensional information characteristic spaces, ANN performed better at capturing complex patterns and RNN outperforms in processing sequential data. While each show considered here showed notable features, our research highlights the importance of a comprehensive approach as none has overall dominance. In this investigation, we offer more than fair the advancement of machine learning applications in healthcare, but too to the on-going talk about early and location that ideally may advantage people at the extreme introvertedness range.

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Exploring machine learning and deep learning models for forecasting bitcoin price trends

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ABSTRACT: The proliferation of mobile devices and personal computing has revolutionized stock and crypto currency trading. While many struggle with navigating trading intricacies, adept practitioners find lucrative opportunities for wealth accumulation. Automated price prediction systems, particularly the Long Short-term Memory (LSTM) model, offer passive trading approaches, eliminating exhaustive decision-making processes. Acquiring and organizing data, followed by rigorous calculations and analysis, culminates in accurate price forecasts. Though not infallible, these models discern trends and project crypto currency trajectories. Notably, Bitcoin serves as a prime example. These systems offer invaluable insights, aiding investors in strategic decision-making amid the dynamic crypto currency landscape.

Keywords: Data Collection, Pre-Processing, Feature Extraction and Currency Prediction

1 INTRODUCTION

A Bitcoin price prediction system utilizes a sophisticated algorithmic framework to analyze various aspects of a crypto currency, including demand dynamics, whitepaper intricacies, tokenomics, public sentiment, and market trends. This analysis guides the system in forecasting the potential price trajectory of the crypto currency. Powered by advanced methodologies like technical analysis and statistical modeling, the system processes vast datasets to extract nuanced insights, improving predictive accuracy. Integration of external inputs further enhances the model's robustness. In this system represents a convergence of algorithmic sophistication, analytical precision, and data-driven insights, aiding in navigating crypto currency valuation complexities. Within AI, Machine Learning (ML) plays a pivotal role, particularly in forecasting financial market dynamics. In models like Multi-Layer Perceptrons (MLP) and Recurrent Neural Networks (RNN) excel in long-term price prediction for Bitcoin, achieving fidelity rates of 60% to 80%. This capability is crucial for navigating the volatile nature of crypto currency prices.

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2 LITERATURE REVIEW

In [1–3] the main aim is to outline the application of machine learning techniques in detecting counterfeit banknotes. The exposition herein will provide an in-depth exploration of our project, furnishing a foundational understanding encompassing the product viewpoint, user requirements, an overview of requirements, and overarching restrictions. Moreover, it will expound upon the specifications and features requisite for the successful execution of this project, encompassing aspects such as interface design, functional requirements, and performance criteria. Through this comprehensive exploration, we aim to elucidate the intricacies and parameters that underpin the endeavor to employ machine learning in the crucial task of discerning counterfeit banknotes.

In [4–6] the scope of this Software Requirements Specification (SRS) document pervades the entirety of the project. It serves as the definitive source delineating the software requirements, collaboratively established by the designers and clients. In [7–10] the papers progresses, the traceability from the SRS to the final product is meticulously maintained, ensuring that all specified functions find manifestation in the executed project deliverables. This document comprehensively elucidates the project's functionality, performance benchmarks, limitations, interface specifications, and overarching dependability considerations throughout its entire life cycle. In [11,14] essence, the SRS functions as the cornerstone, providing a roadmap for the seamless transition of conceptualized software requirements into tangible and functional project outcomes.

3 SYSTEM ANALYSIS

3.1 *Existing system*

The evolving nature of Bitcoin technology has led to a scarcity of existing price prediction models, prompting this study to address multiple time intervals—namely, 10-minute, 10-second, and daily time series data [12]. To enrich the analysis, meticulously curated datasets covering 30, 60, and 120 minutes were utilized. Utilizing the GLM/Random Forest methodology, three linear models were derived from these datasets to collectively forecast Bitcoin prices. Additionally, the author explores methodologies used in forecasting the US stock market. Research findings indicate a correlation between the prediction network's accuracy and market volatility, as measured by excess returns' standard deviation [13,15]. This convergence suggests that examining various financial and economic characteristics can predict market excess returns, offering a potential avenue to enhance prediction accuracy in Bitcoin and other volatile financial markets.

3.2 *Proposed system*

Following recent cryptocurrency valuation fluctuations, Bitcoin has gained increased traction as a preferred investment option due to its heightened market value. Given Bitcoin's inherent volatility, accurate forecasts are crucial for informed investment decisions. This study utilizes machine learning techniques to predict Bitcoin prices across different time frequencies, including daily and high-frequency intervals. Results show machine learning algorithms outperform traditional statistical methods in daily price predictions, achieving accuracy rates of 91% and 90.3%. Additionally, Long Short-Term Memory (LSTM) exhibits exceptional accuracy in forecasting Bitcoin prices at 5-minute intervals, with a rate of 90.2%. The research extends to Ethereum, accurately forecasting its values using the same techniques. Moreover, the system efficiently processes Lite-Coin values four times faster than Bitcoin, catering to Lite-Coin's faster transaction pace. Overall, the study confirms the precision of machine learning methods in forecasting Bitcoin, Ethereum, and Lite-Coin values, offering valuable insights for investors in the dynamic cryptocurrency market.

4 DATA FLOW

4.1 *Data flow diagram*

- Figure 1 also referred to as a bubble chart, illustrates a straightforward yet impactful graphical representation used for depicting the complexities of a system. This visual tool facilitates the portrayal of a system by illustrating the flow of data from its input, through various operations or processes, to the resultant output data. The term “bubble chart” aptly captures the essence of this visual representation, where bubbles symbolize distinct processes or operations within the system.
- Figure 1 stands out as an indispensable modeling tool, playing a pivotal role in the representation of system components and their interactions. Through the utilization of DFDs, various elements constituting the system are effectively modeled, encompassing the system’s processes, the data manipulated within those processes, external entities engaging in communication with the system, and the pathways delineating the flow of information.
- DFD delineates the informational flux within the system, encapsulating diverse transformative processes. Employing graphical representations, this methodology elucidates the dynamics of information flow, elucidating the metamorphoses undergone by data as it traverses the transition from input to output.
- DFD, also recognized as a bubble chart, offers versatility in depicting a system at various abstraction levels. The DFD structure allows for segmentation into phases aligned with escalating functional intricacy and the progression of information flow.

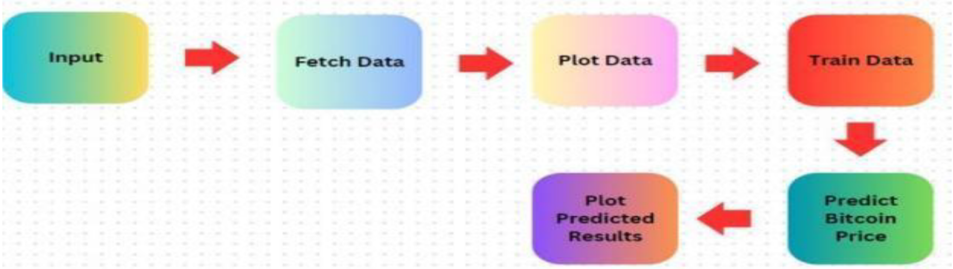

Figure 1. Data flow diagram.

4.2 *UML diagrams*

The initialize UML denotes a Unified Modeling Language, functioning as a standardized, versatile modeling language widely utilized in the domain of object-oriented software engineering. The development and oversight of this standard are attributed to the Object Management Group (OMG) [8], a consortium dedicated to advancing standards in the field of information technology. UML provides a comprehensive and widely accepted framework for visualizing, designing, and documenting software systems, offering a standardized means of communication and representation across the software development community.

4.3 *Use case diagram*

A UML use-case diagram is a form of a behavioural diagram which is created after exhaustive use-case analysis. With actor meaning the roles and their purposes, and between use cases, it represents the relationships in system functionalities. The Figure 2 describes how system functionalities are organised among actors and how actors interact with the functionalities in the system.

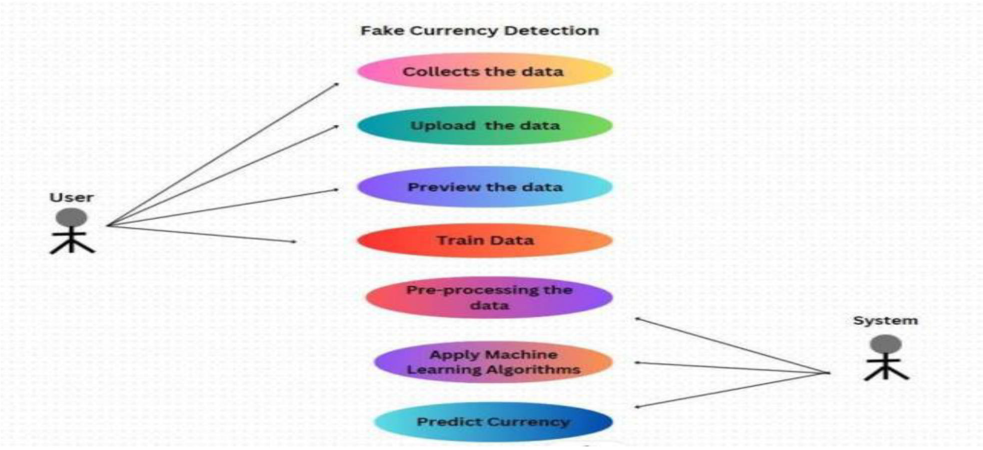

Figure 2. Fake currency detection.

4.4 *Class diagram*

In the realm of software engineering, Figure 3 serves as a static structure diagram within the Unified Modeling Language (UML), showcasing the foundational elements of classes, attributes, operations (or methods), and the interactions that transpire between these classes. This graphical representation provides a comprehensive overview of the structural components within a system, highlighting the relationships and connections between various classes.

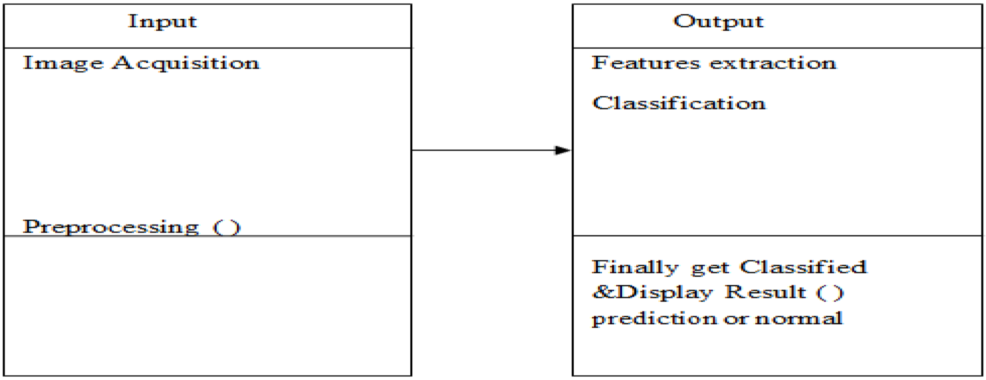

Figure 3. Class diagram.

5 SYSTEM IMPLEMENTATION

5.1 *Module description*

5.1.1 *Data collection module*

Within this module, an extensive dataset of cryptocurrency information has been obtained, encompassing data related to crypto coin rates and their fluctuations over time. The acquired datasets house a wealth of information that has been effectively harnessed for the dual purpose of monitoring historical trends in crypto coin rates and predicting their trajectories in both the past and the future This repository of cryptocurrency data serves as a valuable resource, enabling comprehensive analysis and forecasting activities, thereby contributing to a more informed understanding of the dynamic cryptocurrency market landscape. The utilization of these datasets facilitates robust monitoring, analysis, and predictive modeling, positioning stakeholders to make informed decisions in response to the ever-evolving nature of cryptocurrency rates.

5.1.2 *Pre-processing module*

The datasets procured undergo a systematic preprocessing phase, optimizing outcomes through the implementation of Machine Learning (ML) algorithms. The ML algorithm delves into a comprehensive analysis of the entire dataset, meticulously scrutinizing the acquired data. The preprocessing stage unfolds as a methodical, step-by-step process, enhancing the efficiency of the overall analysis.

6 RESULTS AND CONCLUSIONS

6.1 *Results*

Utilizing machine learning and deep learning algorithms, including LSTM, enables the prediction of Bitcoin prices, Figure 4 displays a comparison between the predicted and actual Bitcoin prices for the period, offering insights into the model's performance. And Table 1 shows the metrices.

Table 1. Metric and predicted values.

Metric	Value
MSE	25.63
RMS	5.06
MAE	3.82
R-SQUARED	0.85

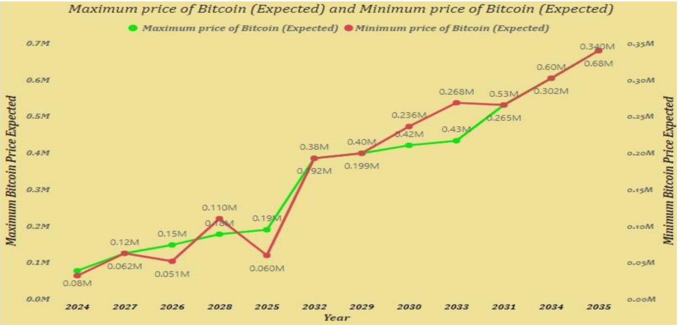

Figure 4. Bitcoin future prediction (2024–2035).

6.2 *Conclusion*

In conclusion, the widespread adoption of mobile devices has completely transformed the landscape of both stock and cryptocurrency trading, ushering in significant advancements. While a notable portion of traders struggles with the complexities of the market, adept practitioners discover profitable opportunities for wealth accumulation. The development of automated price prediction systems, particularly those employing the LSTM model, marks a significant milestone by providing investors with a more passive approach to trading. Following meticulous data procedures, segmentation, and integration, these systems produce models with minimal error rates, thereby enhancing the accuracy of cryptocurrency price predictions. While not claiming infallibility, these models offer valuable insights into market trends and potential trajectories, with Bitcoin serving as a prime example.

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Machine learning and deep learning approaches for brain disease diagnosis: Principles and recent advances

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ABSTRACT: Reasoning Because of their widely differing sign characteristics, mental malignancies, like glioblastoma multi shaped in attractive reverberation (MR) images, are frequently difficult to identify and diagnose. A strong division strategy for cerebrum growth X-ray testing was created and put to the test. Techniques Measurable methods and fundamental constraints are insufficient to segregate the many components of GBM, including nearby difference upgrade, rot, and edoema. Larger informative indices are beyond the reach of most voxel-based techniques, and strategies based on generative or discriminative models are inherently constrained in their applicability (e.g., limited sample set learning and mobility). These two studies collected and analyzed vast amounts of data with the goal of understanding and analyzing brain illnesses as well as demonstrating the intricate relationship between behavior and cognition. Keeping up with, evaluating, and sharing the expanding neuroimaging datasets proved to be quite difficult. To improve representativeness and ease of inspection, multimodal MR images are computationally split into super pixels. Highlights were then taken out of the super pixels using staggered Gabor wavelet channels. In light of the elements, a liking metric model for growths and a grey level co-occurrence matrix (GLCM) model were created to address the shortcomings of earlier generative models.

Keywords: Image Segmentation, Deep Learning, Brain tumor

1 INTRODUCTION

Deep learning is a branch of artificial intelligence that focuses on training artificial brain networks to carry out tasks by mimicking the complex network architecture of the human brain. Fundamentally, deep learning involves building deep neural networks in the brain, each consisting of several layers that logically accumulate and focus progressive representations from data. These companies are equipped with vast amounts of identified data, which enables them to subsequently identify confusing instances, focal points, and relationships within the data. Profound learning has demonstrated impressive results in a variety of domains, including as clinical diagnoses, normal language handling, and picture and discourse recognition. In computerized imagery, a key task akin to a painter's brushstroke involves precisely defining boundaries and locations within an image, known as "image segmentation." This computing process allows machines to perceive and understand the visual environment with high precision. Image segmentation divides an image into distinct and important areas, separating them from the background, thus transforming a complex mix of pixels into an organized map of elements. Despite its apparent simplicity, this process has significant applications in various industries, including computer vision, autonomous robotics, satellite image analysis, and medical imaging.

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2 LITERATURE SURVEY

In this approach, Jasmine Paull [1] *et al.* have suggested that the primary method of treating mental illnesses is to accurately identify the growth type, area, size, and boundaries. Using robotized and semi-mechanized methods, appealing reverberation images (X-rays) can be used to investigate the characteristics of the perfect district, such as tissues and growths. In this sense, extracting the X-ray image of a cerebrum cancer is a challenging task in clinical image processing. The significant problems associated with a doctor's X-ray inquiry are time-consuming, and the accuracy depends on the doctor's skill. The PC supported conclusion (computer aided design) innovation can overcome this limitation. This research presents a computer-aided design framework that uses T1 and T2 weighted MR images to help differentiate cerebrum growths with PC assistance. The designed framework uses a creative automated technique that increases the presentation and reduces the complexity associated with the cancer detection to characterize the growth into innocuous or threatening from MR Pictures. The Overall Alzheimer's Disease Neuroimaging Drive (WW-ADNI) is a collaborative effort to investigate imaging and biomarkers that can shed light on Alzheimer's disease treatment preliminary steps, as suggested by Christopher J. Weber [2] *et al.* North America, Argentina, Australia, Canada, China, Japan, Korea, Mexico, and Taiwan are all visited by a public-private organization. Scientists from ADNI began a naturalistic, longitudinal review in 2004 and it is still ongoing today worldwide. The review has driven tau and amyloid phenotyping and polished neurosis through a few successive stages (ADNI-1, ADNI-GO, ADNI-2, and ADNI-3). According to Simeon Spasov [3] *et al.*, this framework Certain varieties of mild mental illness (MCI) are the clinical precursors of Alzheimer's disease (Promotion); other types of MCI will typically remain stable over time and do not progress to Promotion. We wish to develop goal estimations that can separate the MCI patients who are at risk of advertisement from those MCI patients who have fewer chances to foster promotion in order to identify and select effective and tailored systems to prevent or delay the movement of promotion.

3 EXISTING SYSTEM

The brain is our body's central nervous system. As time goes on, more recent and acute brain disorders are being discovered. As a result, current conclusion or location frameworks are getting tested and remain an open topic for research due to the malleability of mental diseases. Early detection of mental health disorders can significantly impact efforts to treat them. Artificial intelligence (AI) is becoming more and more prevalent in all fields of study, and the field of nervous system science is probably one of them. The prediction and discovery of cerebrum illness have become more precise because to the application of simulated intelligence in clinical research. We provide an overview of deep learning and late artificial intelligence methods for diagnosing four mental diseases: Parkinson's disease, epilepsy, Alzheimer's disease (Promotion), and cerebrum growth. 147 late papers about four mental diseases.

4 PROPOSED SYSTEM

The inner region of the MR image dataset needs to be distinguished from other organs, which is why the Grey Level Co-Occurrence Matrix (GLCM) Homomorphic Function is the one that is suggested. Next, a modified gradient magnitude region expanding approach is used, in which the Sobel operator is used to compute the gradient magnitude, which is then used as the homogeneity criterion definition. Stable boundary detection was made possible by this method even in cases when the gradient has gaps and intersection variations. By examining the gradient's magnitude, enough contrast is revealed on the boundary, improving segmentation accuracy. The relabeled approach is based on remapping the labels associated with each object in a segmented image so that the label numbers are sequential and there are no gaps between the label numbers used to compute the size of the segmented tumor. A binary threshold can be used to extract any object from the relabeled output. In this case, the BAT technique is modified to extract the tumor, rename it, and then calculate its pixel size.

4.1 *MRI preprocessing*

Preprocessing images typically entails removing reflections, veiling portions of the images, normalizing the force of individual pragmatic images, and removing low recurrence. The process of enhancing information through visuals before it is handled computationally is called picture handling. Different combinations of skills are utilized for growth division and arrangement in the ensuing stage. Include values are then directly fed into the AdaBoost classifier to characterize non-growth and cancerous regions. Managing classifier preparation involves manual naming to growth zones. Then, using the constructed classifiers, obscure mind X-rays are used to identify cancer or non-growth fragments.

4.2 *Bias feature extraction*

One remarkable application of dimensionality reduction is highlighting extraction. When the amount of data for a calculation becomes too large to handle and is deemed to be remarkably repetitive (e.g., similar estimation in two feet and metres), the data will be transformed into a reduced representation set of elements (also known as a highlights vector). Include extraction refers to transforming the data into an elemental layout. In order to do the optimal assignment using this reduced portrayal rather than the usual info, the highlights set will typically extract the important data from the information, assuming the pieces separated are meticulously chosen.

Bat Brain Tumor Segmentation and Classification from Non-Tumor Tissue: In a high aspect highlight space, an assist vector machine searches for the optimal isolating hyperplane between people and non-individuals from a particular class. The component subsets selected throughout the information pre-handling and extraction steps contribute to the bat computation. Graph, polynomial, RBF, and other kernel functions are utilised in grey level co-occurrence matrix (GLCM) calculations. Among these kernel functions, the fact that the vectors are nonlinearly transferred to a very high dimension feature space makes a Radial Basis Function (RBF) helpful. MRI pixels are used as samples for the segmentation and categorization of tumor/non-tumor tissue. A collection of feature values that were taken from several MRI modalities are used to represent these samples.

Homomorphic Algorithm for Segmentation Is as Follows: Acquire the blocks of the sub-image, beginning in the upper left corner. Utilizing a two level 2-D Grey Level Co-Occurrence Matrix (GLCM), break down sub-image blocks. Compute Grey Level Cooccurrence matrices or Spatial Grey Level Dependence Matrices (SGLDM). Every two-level high frequency sub-band of the decomposed sub picture blocks has an average of 0 degrees for θ and 1, 45, 90, and 135 degrees for distance. The following nine Haralick second order statistical texture characteristics, known as wavelet Co-occurrence Texture features (WCT), are recovered from these coccurrence matrices.

5 RESULT ANALYSIS

A homomorphism classifier for the grey level co-occurring matrix (GLCM) that ignores interactions between neighboring data point labels. On the other hand, although DRFs and MRFs take these interactions into account, they lack the attractive generalization qualities of Radial Basis Function. This section will go over our GREY LEVEL CO-OCCURRENCE

MATRIX (GLCM), which is an RBF extension that models' interactions in the labels of neighboring data points.

$$p(y|,x) = \frac{1}{Z}\exp\left\{\sum_{\mathrm{i}\in \mathrm{S}} \log(\mathrm{O}(\mathrm{y_i}, \gamma_{\mathrm{i}}(x))) + \sum_{i\in S}\sum_{j\in N_i} V(y_i, y_j, X)\right\} \tag{1}$$

where O (y_i, γ_i (x)) is an SVM based Observation-Matching potential, V (y_(i,) y_j, X) is the Local-Consistency potential over a pair-wise neighborhood structure, and N_i are the eight neighbors around position i. η_i (x) computes feature from the observations x for location i.

T1 image, T1 image with contrast agent, T2 image, enhancing area label, edema label, gross tumor label, full brain segmentation are shown in Figure 1. Accuracy of the proposed method is 90 whereas for the exisiting method is only 85.

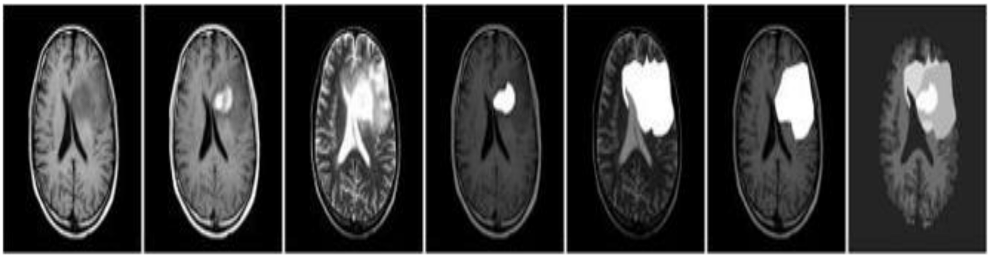

Figure 1. T1 image, T1 image with contrast agent, T2 image, enhancing area label, edema label, gross tumor label, full brain segmentation.

6 ALGORITHM DETAILS

6.1 *Bat algorithm*

BAT algorithm, well-known for its optimization ability offers a quicker convergence rate when compared to other contemporary optimization techniques, and it is quite good for performing medical image segmentation. The introduction of BAT algorithm has been made by Zhang *et al.* and it has a unique principle called echolocation, which is an inbred quality possessed by bats.

```
Function preprocess_MR_image(image_dataset):
Apply GLCM Homomorphic Function to distinguish interior area
Implement modified gradient magnitude region growing algorithm:
Compute gradient magnitude using Sobel operator
Use gradient magnitude as homogeneity criterion for boundary detection
Function calculate_tumor_size(segmented_image):
Apply relabeled method to remap labels with consecutive numbers
Use BAT algorithm to extract and relabel the tumor:
Determine input image labels and count pixels in each label (first stage)
Determine output requested region for total number of accessed pixels (second stage)
Calculate size of segmented tumor in pixels
Main():
Load MR image dataset
Call preprocess_MR_image function on the image dataset
Obtain segmented image
Call calculate_tumor_size function on the segmented image
Output the size of the segmented tumor in pixels
```

7 CONCLUSION

Two recent developments in the literature on brain tumor segmentation are combined in this paper: model-aware similarity and affinity calculations using grey level co-occurrence matrix (GLCM) models with evidence terms based on GLCM. We accomplish this by making three key contributions. In order to lower the computational cost, enhance spatial smoothness, and resolve the data sampling issue for Grey Level Co-Occurrence Matrix (GLCM) classifier training on brain tumor segmentation, we employ super pixel-based appearance models. Furthermore, we create an affinity model based on model-level constraints learned from the training data, which penalizes spatial discontinuity. Ultimately, it is demonstrated that the false positive regions are successfully eliminated by our structural denoising, which is based on the symmetry axis and continuity features.

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An integration of electrical vehicle into grid along with hybrid energy storage system for power management

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ABSTRACT: The incorporation or perturbation of non-conventional energy sources into the power distribution system presents a formidable obstacle to highly efficient power system that has already been established. The research focuses on the manner in which the integration of a hybrid energy improves efficiency by decreasing average power and power transients this enables swift operation and DC voltage regulation. By utilizing the state of charge of the battery to ascertain the power distribution between the utility and the hybrid storage system, an effective energy management scheme seeks to increase grid dependability by bolstering the capacity to accommodate peak demands and mitigate fluctuations caused by solar photovoltaic power. In the simulation environment, the operation and regulation of the proposed energy management scheme are also taken into account. The simulation investigations demonstrate that the control scheme mitigates the strain and abrupt current fluctuations that can occur on the storage system due to unanticipated power distribution and load demand, and effectively facilitates the settling of PV power.

Keywords: Photo Voltaic (PV), Hybrid Energy Storage (HES), Electric Vehicle (EV), Household Energy Management (HEM)

1 INTRODUCTION

In contemporary times, power systems are emphasizing a surge in the implementation of renewable technologies in response to the imperative for energy conservation and the rapid proliferation of such sources. The systems that receive the most attention are photovoltaic (PV) and wind turbines. PV is the optimal choice owing to its dependability and indestructibility, in addition to its low operating cost, high efficiency, nominal maintenance cost, and consistency, all of which are regarded as PV system advantages. However, variations in environmental conditions including temperature, humidity, shading effects, and solar irradiation have an impact on the generation factor and stability of photovoltaic (PV) systems, which affects the regulation and stability of the combined system in an indirect manner. In order to prevent power outages caused by discontinuous sources such as photovoltaic (PV), energy storage systems are connected to microgrids.

2 LITERATURE REVIEW

In [1–2] paper reduces the power difference between generation and demand, i.e., the regulating output power condition mode, which improves the PV system's stability.

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Various authors has contributed in the integration of electrical vehicles to grid In order to reduce the impact of solar photovoltaic (PV) systems and provide utility support, this study proposes a controlled charging and discharging strategy. Additionally, the methodology dynamically modifies charging and discharging rates in order to maintain the operational readiness of PEVs and accommodate fluctuations in power. In [3–6] the economic feasibility of integrating energy storage technologies, such as electric vehicles (EVs), into distribution networks is assessed. Using a general model, the authors assess EVs as grid-connected storage devices. This model allows administrators of distribution systems to assess the initial viability of such systems, with a specific emphasis on the potential for electric vehicles to supply power into the grid (known as vehicle-to-grid, V2G). The research aims to optimize the capacity of batteries in distribution networks. In [7] an innovative approach is utilized to evaluate power limiting demand response (DR) and dynamic-pricing solutions that facilitate bi-directional energy utilization for energy storage systems and electric vehicles (EVs).

In [8–10] a household energy management (HEM) system is simulated through the implementation of mixed-integer linear programming (MILP). Multiple DR techniques, distribute renewable energy generation, EV V2H and vehicle to grid capabilities, and two way energy trading are all incorporated into this innovative technology. In [11–12] an inventive approach employs vehicle-to-grid (V2G) devices to mitigate fluctuations in large scale wind power generation. Energy management and optimization design are necessary for this. Grid connected wind, electric vehicle, and supercapacitor power levels are computed by the system utilizing a proprietary methodology. An EV optimization model based on the knapsack problem is also created to accommodate the various requirements of an EV fleet. In conclusion, dynamic programming enhances the efficiency and depend ability of the power grid by optimizing the dispatch strategies for EV and wind power. In [13–14] the present study investigates the merging of plug-in vehicles, a significant element in the modernization of power systems, into the power infrastructure. PEVs employ real time energy prices to determine the most economical charging strategies every five minutes. PEVs could provide voltage support for the distribution network in a matter of seconds, enabling greater utilization of distributed solar PV systems. According to simulations conducted in the real world, this voltage support may be economical for PEV owners, surpassing distribution network modifications as a viable option for PV array support. In [15] this study examines an innovative method for stabilizing a DC distribution system utilizing PHEVs in conjunction with an AC power grid. Utilizing PV modules, the system is linked to the AC grid via voltage-sourced converters and is capable of producing renewable energy. The research develops mathematical models for both the original and enhanced systems in order to demonstrate how the proposed method increases the stable operating range of the DC distribution system.

3 STRUCTURAL MODEL OF HYBRID ENERGY SYSTEM

The formal design of the suggested hybrid system is depicted in Figure 1. The system consists of an EV, a PV system, and a wind energy conversion system (WECS) connected to an AC bus. Depending on the needs, the system can function in either islanded or grid-connected mode. The PV array is linked to the point of common coupling through a DC-AC converter. The perturb and observe MPPT technique has been utilized to optimize the extraction of solar energy from PV arrays. The electric vehicle (EV) is linked to the power grid by a bidirectional converter. The bidirectional converter's purpose is to facilitate power transfer between electric vehicles (EVs) and the grid, enabling the discharging and charging of the EVs in response to fluctuations in power from the solar and wind energy system.

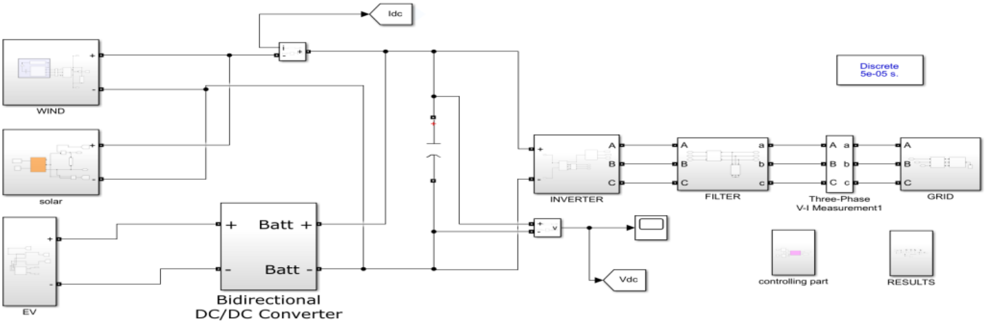

Figure 1. EV Integrated to grid along with hybrid energy sources.

3.1 *PV system model*

The mathematical model of a photovoltaic (PV) panel that converts sunlight into electricity comprises solar irradiance, temperature, panel parameters, and efficiency. PV panels have a mathematical outline:

$$P(t) = P(n) * [1 + \beta * (T - NOCT)] * G(t) \tag{1}$$

$$T = T_a + (NOCT - T_a) * G(t)/G(n) \tag{2}$$

3.2 *EV model*

An electric vehicle (EV) can be used as a means of storing energy and participating in power dispatch to smooth out fluctuations in solar output. When an electric vehicle is linked to the power grid, the EV dispatch takes into account different limitations. State-of-charge (SOC): This includes both the user's desired SOC (Sdep) and the min and max allowable SOC limits (Smin and Smax) for participation in dispatch.

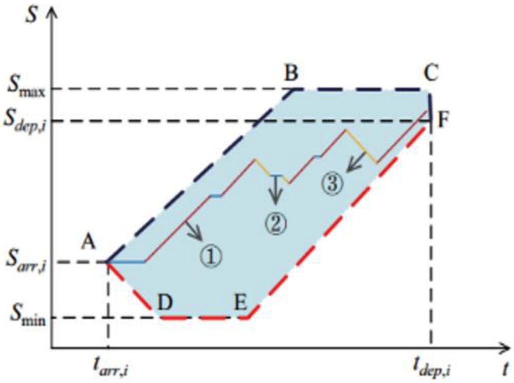

Figure 2. State of charge of an EV.

Figure 2 depicts the functional cycle of an EV, including its SOC variations during charging and discharging. The Y-axis (S) represents the EV's SOC, while $S_{\min}$ and $S_{\max}$ define the acceptable range for participation. t_{arr} and t_{dep} represent the arrival and departure times, respectively. S_{arr} represents the initial SOC upon connection, and S_{dep} is the user's desired SOC. The path represented by A-B-C indicates the maximum SOC boundary during dispatch. The EV charges immediately upon connection, reaching Smax and staying at that level until departure. The path D-E-F shows the minimum SOC boundary. Discharge starts immediately, and it continues until reaching $S_{\min}$, after which discharge stops. If connected for a longer duration, the EV might remain uncharged until the mandatory charging time arrives. This mandatory charging (represented by path EF) ensures sufficient SOC for user travel.

3.3 *Wind power model*

The output of wind power is to evaluated by the stochastic wind speed, which is represented by the Weibull distribution function with two parameters, which is extensively employed. The active output of a wind turbine and wind speed are expressed as:

$$P_{wt} = \begin{cases} 0, \ v_t < v_{in} \ \ or \ \ v_t \geq v_{out} \\ P_{rated} \dfrac{v_t - v_{in}}{v_{rated} - v_{in}}, \ \ v_{in} < v_t < v_{rated} \\ P_{rated} v_{rated} < v_t < v_{out} \end{cases} \tag{3}$$

4 CONTROLLER FOR POWER ELECTRONICS CONVERTERS

4.1 *Reference frame transformation*

This process converts three-phase AC quantities (voltages and currents) into a rotating reference frame called the dq frame, which synchronizes with the AC grid. The grid's phase angle (θ_s), obtained from the Phase-Locked Loop (PLL), is used for this transformation:

4.2 *dq-axis model*

This simplified model represents the dynamics of the Voltage Source Converter (VSC) within the dq frame. It typically includes:

4.2.1 *dq-axis voltage equations*

These equations relate the dq-axis voltages (Vd, Vq) to the DC voltage (Vdc), converter inductances (Ld), and dq-axis currents (Id, Iq) through inverter and filter dynamics.

4.2.2 *dq-axis current equations*

These equations relate the rate of change of dq-axis currents (did/dt,diq/dt) to the dq-axis voltages (Vd,Vq),converter resistance (Rs), back-electromotive force (EMF) of a motor.

4.3 *Reference current generation*

This block determines the desired reference dq currents (Id_ref, Iq_ref) based on the active and reactive power setpoints (Pref, Qref):

$$\left.\begin{aligned} P_{ref} &= \left(\frac{3}{2}\right) * V_{dc} * I_{d\_ref} \\ Q_{ref} &= \left(\frac{3}{2}\right) * V_{dc} * I_{q\_ref} \end{aligned}\right\} \tag{4}$$

4.4 *Current regulation (PI Control)*

This block utilizes Proportional-Integral (PI) controllers to regulate the difference between the reference dq currents (Id_ref, Iq_ref) and the measured dq currents (Id_mes, Iq_mes)

4.5 *Inverse park's transformation*

This process converts the reference dq voltages (Vd_ref, Vq_ref) back to the three-phase AC reference voltages (Uabc_ref):

$$[U_{abc\_ref}] = T^{-1}(\theta_{\_s}) * [V_{dq\_ref}] \tag{5}$$

4.6 *PWM generation and VSC inverter*

The reference voltages (Uabc_ref) are used to generate Pulse Width Modulation (PWM) signals that control the switching pattern of the VSC inverter's switches.

4.7 *Algorithm outline*

Measure three-phase AC voltages (Vabc) and currents (Iabc). Perform Park's transformation using the grid angle (θs) to obtain dq-axis voltages (Vdq) and currents (Idq). Generate reference dq currents (Idref, Iq_ref) based on desired active and reactive power set points (Pref, Qref). Implement PI control to compare reference and measured dq currents, generating control signals (Vdref, Vq_ref). Perform Inverse Park's transformation to convert control signals into three-phase AC reference voltages (Uabc_ref). Generate PWM signals based on reference voltages (Uabc_ref) to control the VSC inverter.

5 SIMULATION RESULTS

The simulation findings indicate that the required quantity of electric vehicles throughout the specified time period is closely correlated with the demand for EVs. The analysis conducted above indicates that the schedulability of electric vehicles (EVs) is influenced by various aspects, such as EV mobility. The simulation results indicate that the grid voltage may be adequately supported, as shown in Figures 3 and 4. Figures 5 and 6 illustrates the electric vehicle's capacity to supply active power to the grid. The simulation results illustrate this capacity during grid load.

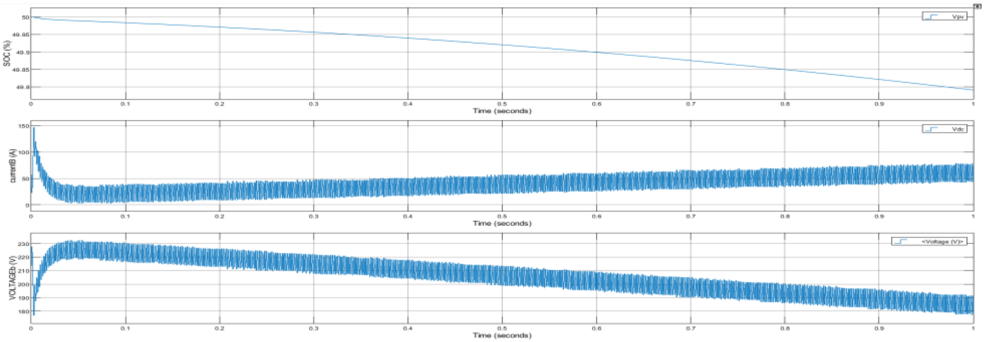

Figure 3. State of charge (b) battery voltage and current (c) battery current.

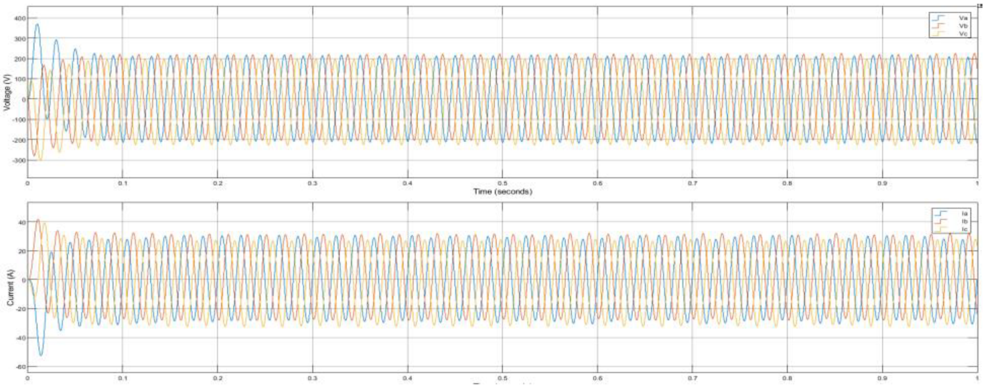

Figure 4. Grid voltage and current.

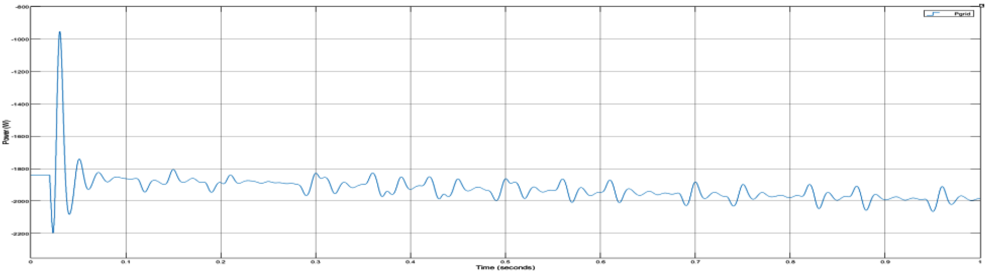

Figure 5. Grid active power.

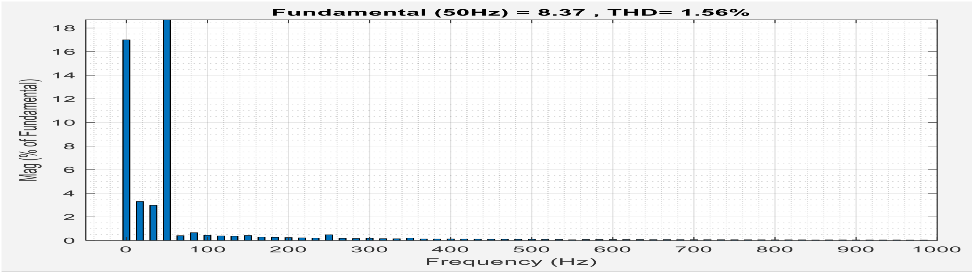

Figure 6. Total harmonic distortion for grid currents.

6 CONCLUSION

This study presents a novel V2G method for PEV battery discharging, which entails dynamically altering charging rates based on remaining battery capacity and potential travel needs, and strategically charging PEV batteries during midday to absorb excess solar energy. This approach offers several advantages over traditional constant-rate strategies. It leverages PEV battery capacity more efficiently and aligns better with hybrid (solar & wind) generation and load profiles, resulting in more targeted mitigation and support during critical periods. Similarly, during the evening peak load, the strategy allows controlled discharge of PEV batteries to inject stored energy back into the grid while ensuring sufficient remaining capacity for potential evening travel. Further research can be continued with the practical system.

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Enhancing rice grain classification using color features and self learning neural network model

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ABSTRACT: In this research paper, we have classified the eight different classes of rice grains using six types of color combinations. It is mentioned that the performance of self-learning neural network model (SLNNM) as a classifier is the most consistent and accurate among others; hence, it is best suited for rice classification. (Such as LDA and BPNN) also achieve satisfactory performance. Feature sets with Matrix-like structure give, compared to other engineered expression features, promising classification accuracy with less number of required set of expressions which makes them very effective. To summarize, the result suggests that those color feature with contrast-related information should be preferred to HSI color feature. This highlights the necessity of meticulous selection of features and classifier for better performance. In future studies, rice grain classification or similar tasks can obtain higher accuracy and efficiency in the aspect of research reformulation and methodology adjustment by drawing lessons from these conclusions.

Keywords: Grain classification, Color features, SLNNM, Co-variance matrix-based features, Pattern recognition and Classifier selection.

1 INTRODUCTION

Colours represent the way our brain perceives visible light when it reaches the retina. They are not only captivating and easily understood aspects of any picture, but they also play a crucial role in capturing the beauty of nature in photographs [1]. There are two important reasons why incorporating colour in image processing is encouraged. Firstly, colour serves as a powerful descriptor that enables the identification and differentiation of objects in a scene, thus aiding in object recognition and classification. Secondly, the human eye has the ability

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to discern numerous shades and levels of colour, unlike the limited range of gray variations. This characteristic proves advantageous when manually analyzing images using the human visual system.The processing of pictures based on colour can be divided into two primary categories: full-colour processing and pseudo-colour processing [2]. Full-colour processing, also known as true hue processing, encompasses the capture, display, and printing of images in their complete colour spectrum. The range of colours that can be displayed is determined by the capabilities of the computer systems we use. It is difficult to imagine a scenario where colour images would not be beneficial since they find utility in various fields. However, in the medical domain where grayscale images are predominant, the use of colour images is not as common. Therefore, full-colour processing is advantageous in any field where vibrant, full-colour images are employed. On the other hand, pseudo-colour processing involves assigning artificial colours to a black and white image. For example, based on the intensity values, colour can be applied to a grayscale image to aid in image analysis. The process through which the human brain perceives and comprehends colour is referred to as a psycho-visual phenomenon and remains partially unexplained. However, based on both experimental and theoretical research, the physical nature of colour can be formally defined [3]. When a beam of white light passes through a prism, it is refracted and separates into rays of different colours. In 1666, Sir Isaac Newton discovered that white light can be split into seven distinct colour spectra, ranging from violet on one end to red on the other. Additionally, each of the seven hues gradually transitions into the next, indicating that there are no abrupt boundaries in the colour wheel. The way humans perceive colour in objects mainly relies on how light is reflected from those objects. If the light reflected by an object includes all the wavelengths of visible light, it appears white to an observer. The visible spectrum consists of twenty-four frequencies. However, when an object reflects light waves within a specific range of the visible spectrum rather than the entire range, it appears as a specific colour instead of white. For example, if an object predominantly reflects light with wavelengths between 450 and 495 nanometres while absorbing other wavelengths, it appears blue to an observer. The study of colour is based on the categorization of light. Achromatic light lacks colour and is solely characterized by its level of brightness. On the other hand, chromatic light refers to light that encompasses a range of hues across the entire visible spectrum, which spans frequencies of 400-700 nm. The most basic terms for of a colored light source are radiance, brilliance and luminance. Radiance is watts per square meter and is the total amount of energy being given off, but luminance is lumens per square meter, which is the perceived total. An observer can be easily blinded even by a high brightness candle, but a highly radiant light source at or even beyond the near infrared wavelengths, may appear as a dark object to the same observer. This value (mainly 0 to 1) represents how bright a color is, but with 0 information about what color the brightness is referring to. Color is seen by the cone photoreceptor cells in our eyes. Each area of color has say 6-7,000 cones in the human retina categorized into three types of colors - red (65%), green (33%) and blue (2%). Blue cones were the best at sending messages, even though there were fewer blue cones. The light-absorptive nature of these cones means that we experience colors as mixtures of red, green and blue.

2 LITERATURE SURVEY

In recent research, computer image processing has been aimed at viniculture for grape identification and counting as an alternative approach thanks to its efficiency and robustness compared with classical methods. Correct grain identification is of benefit to both farmers and consumers as easily identifying grains will allow them to increase yield rates a well avoid purchasing substandard goods. Various intelligent systems based on digital image processing techniques have emerged to cater the consistency of quality assessment in agriculture and food industries. Physical characteristics and color have been identified as important attributes for labelling, especially by some other systems. (Case Studies)Another systematic review that was conducted on mechanical visual changes for wheat grain classification has shown the drawback of depending on one feature subset only. Classification performance can be enhanced by combining more than one set of features. Therefore, with the application of imaging techniques differing through shape, color and texture had developed high classification accuracy rates among several food grains. In addition, many features are analyzed for their classification efficiency and the shape, color, and texture were important features to differentiate between several seeds types: fruits as flowers. “It has been proved through various researches that manual grain classification can be replaced using the image processing techniques for the development of automated systems with highest possible accuracy level as compared to human work.” Several research papers have been published for rice quality assessment by using image processing methods with different classification accuracy rates for various rice cultivars. In summary, the advent of computer image processing in relation to grain identification and classification has significantly transformed agricultural and food industries, by availing quality assessment methods which are not only fast but also reliable.

3 PROPOSED WORKFLOW

The architectural model for providing responsive function may change shape to identify environmental factors. This kinetic motion elements of buildings where based on changes over environment like organism. This is based on motion envelope which may facilitate actuation of artificial intelligence, sensors, computer program and mechanical factors. There is no aesthetic influence that are expected with constant modification of elements over the environment, however it may show energy consumption that may reduce optimal response with diverse changing factors like buildings. Elder home monitoring system shown in Figure 1.

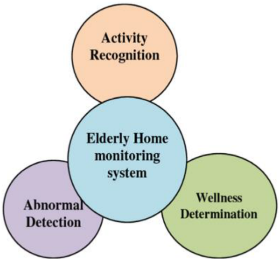

Figure 1. Elder home monitoring system.

Table 1. Standardization of elder move.

Elder behavior in home		Standardized method	Proposed standard
Living room	General	30-40	75-100
	Recreation	150-200	200-300
	Working	400-600	300-500
	reading	400-600	300-500
Bed room	General	100-150	100-150
	Reading	400-600	750-1000

The shape of the architectural model can be altered to express the interaction between different components of the environment, for example, energy consumption and comfort for seniors, using devices and feedback loops to change the environment and user needs. Devices can be moved in real-time to alter the internal environment of the depending on changing conditions. The influencer can be determined by the security system, based on users’ perception, and integrate structures for kinetic motion in different environmental conditions. The RGB color model utilizes them as digital image components based on red, green, and blue; however, HSI color model uses human perception-based components; hue, saturation, and intensity. The classification and extraction of color images may be performed using RGB and Human-Based HSI color models for a broad variety of outcomes, including rice grains, particles, and biological categories such as agricultural products identification. HSI Color Model describes intrinsic color components, hence ideal for visual processing. Equations from this study are employed to extract various color planes in the original color image in MATLAB. Table 1 show the standardization of elder move.

Table 2. List of 18 colour features based on RGB and HIS.

Sl. no.	9 RGB Colour Features	Sl. no	9 HSI Colour Features
1.	Red mean	10.	Hue mean
2.	Red variance	11.	Hue variance
3.	Red range	12.	Hue range
4.	Green mean	13.	Saturation mean
5.	Green variance	14.	Saturation variance
6.	Green range	15.	Saturation range
7.	Blue mean	16.	Intensity mean
8.	Blue variance	17.	Intensity variance
9.	Blue range	18.	Intensity range

A covariance matrix is a square array that represents the variability and covariance between all possible pairs of variables. The matrix has variances along the main diagonal, indicating the variance or covariance between the same pair of variables. A covariance matrix is constructed for each of the two hue models, RGB and HSI, resulting in two covariance matrices for the two hue models discussed in this study. Figures 2(a) and (b) illustrate the steps involved in gathering co-variance colour features, while Table 3 presents a comprehensive list of these co-variance color features.

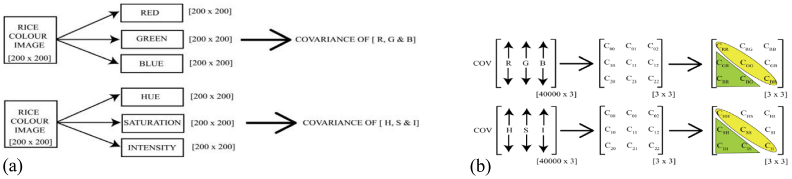

Figure 2. (a) Extracting image planes for obtaining covariance matrices. (b) Obtaining co-variance matrices from RGB and HSI colour planes.

Table 3. List of 12 colour features based on RGB and HIS.

Sl. no.	6 RGB Color Features	Sl. no	6 HSI Color Features
1.	Co-variance between R itself (C_{RR})	7.	Co-variance between H itself (C_{HH})
2.	Co-variance between G itself (C_{GG})	8.	Co-variance between S itself (C_{SS})
3.	Co-variance between B itself (C_{BB})	9.	Co-variance between I itself (C_{II})
4.	Co-variance between G and R image planes (C_{GR})	10.	Co-variance between S and H image planes (C_{SH})
5.	Co-variance between B and G image planes (C_{BG})	11.	Co-variance between I and S image planes (C_{IS})
6.	Co-variance between B and R image planes (C_{BR})	12.	Co-variance between I and H image planes (C_{IH})

4 EXPERIMENTAL BACKGROUND

The study presented in your proposal is about analyzing and categorizing eight different types of rice grains according to their color categorizes. The following presents a summary of our process and key findings (Figure 3):

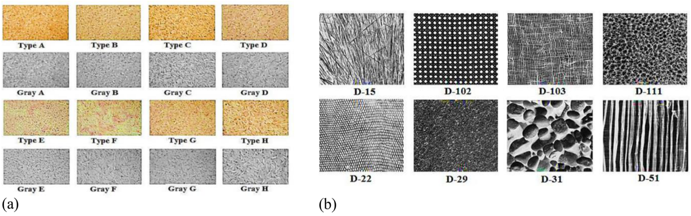

Figure 3. (a) Sample images of eight varieties of bulk rice grains. (b) Eight different classes of standard texture images.

The data collection: Video footages of the eight rice grain varieties were taken using a Nikon digital camera equipped with a CCD sensor in an outdoor natural lightening condition. A total of 100 frames were extracted from this footage for each rice kernel type, leaving a collection of 800 color images (*). Image Processing: The color images taken were resized to reduce the complexity of its computation, as 200x200 pixels dimensions. Color characteristics of the images have been extracted from each image by utilizing the different levels in two hue planes (RGB and HSI). Moreover, the complexity level for each RGB components were calculated. In addition, eight texture images from Brodt's texture database were considered as well.*"A classification model is established after the extraction of color characteristics."* that our classifier called Backpropagation Neural Network (BPNN) perform is better than other classifiers like KNN and LD. Results: Three BPNN classifier using 9 RGB color features performed better than the remaining classifiers with at least 97% in terms of classification accuracy.

For a given combination of eighteen features used simultaneously, the accuracy of all classifiers except for KNN is greater than 95%. TABLE X-Accuracy rate for all classifiers using 6 RGB covariance color features since six of the RGB covariance color features yielded better results than other features. In addition, they achieved an excellent classification rate using both LDA and BPNN classifiers. HSI hue planes generally provided more consistency and uniformity for all the classifiers, which may be attributed to that HSI was according with human vision perception. The classifiers all performed above 90% for six combined features and twelve HSI covariance plus combined of the two for which the performance of nine hue features (HSI) degraded due to widely dispersed features within classes and densely populated means (Figure 4).

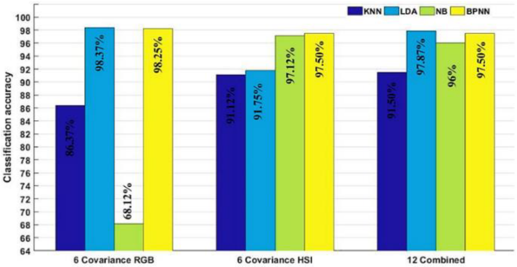

Figure 4. Performance of different co-variance color features.

We have observed from this study that HSI color properties create more consist, as well covariance attributes are essential features to quantify the relationship between image planes. Results also show that the six HSI covariance features have better class separability than nine HSI hue features. The results of this study show that color feature, especially in RGB and HSI color space can be used to classify rice grain variety. In conclusion, The BPNN classifier obviously has excellent performance stability for all features and is well suited to this pattern recognition task.

4 CONCLUSION

The objective of this study is to classify eight rice grain varieties with six individual chucks of color features. As seen in Table 2, the SLNNM model demonstrates stable accuracy on all the sets and LDA along with BPNN also gives remarkable results. The covariance matrix-based features demonstrated to be accurate, especially in the HSI color space. However, its efficacy on other types of tasks may not be guaranteed and hence one has to choose the features/ classifier carefully. For further work on rice grain classification, this study has given some useful contribution as well.

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Assessment of organizational human resource management performance through machine learning techniques

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ABSTRACT: The use of machine learning models holds promise for expediting the hiring process in the dynamic sector of talent acquisition. Using a sizable dataset of 500 resumes and interview replies from 200 candidates for training and an additional 150 resumes and 70 candidate comments for model validation, this study explores the challenging areas of resume shortlisting and applicant selection. We thoroughly evaluate the performance of machine learning models in terms of accuracy, precision, recall, and F1-Score using Artificial Neural Networks (ANN), Convolutional Neural Networks (CNN), Naive Bayes (NB), Support Vector Machines (SVM), Random Forest (RF), and Decision Trees (DT). The results highlight the ANN's better performance, which includes a 97.5% accuracy rate, while showcasing the dynamic advantages of each model. A careful examination of confusion matrices also demonstrates the trade-offs each model makes between recall and precision. For businesses looking to improve their hiring practices through data-driven decision-making, these findings present new opportunities. This study stresses how machine learning can streamline the hiring process and stay up with talent acquisition requirements in today's competitive employment market.

Keywords: Machine learning, HR management, Interview, candidate, Neural network

1 INTRODUCTION

Machine learning technologies are altering the talent acquisition trend, enhancing qualities of speed, accuracy and efficiency in recruiting candidature. more and more — traditional decision-making is being replaced with machine learning models that do a much better job of providing objective and accurate assessments on the candidate. Nowadays, due to the fact that there is so much data out there and because technology has brought us a long way in terms of

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computing power machine learning applications are being widely used in all areas including the recruitment sector. Therefore, the primary purpose of this paper is to compare various machine learning models in terms their efficiency while screening and selecting candidates. “Via models like Scribe and Adapt, companies are able to ensure they are hiring the top 1% of applicants by sifting through resumes and responses without inherent bias.” For instance, in the skill-based recruitment process, resumes are scanned using natural language processing (NLP) to look at candidates’ qualifications and experience and machine learning models can be used to analyze the quality of interview responses. Various machine learning models such as ANN, CNN, NB, SVM, rf and dt are compared with each other based up on recall, precision accuracy f1-score. However, each one of these models have their own advantages and disadvantages. It’s up to the companies to select which model can fit into its requirements. In general, this study seeks to enhance productivity, efficiency and flexibility in the area of talent acquisition so as to comply with the needs of the emerging labour market. Companies will be able to utilize machine learning technology in order to better the recruitment processes, shortlisting of qualified candidates, and data-driven insights to enhance their hiring mechanisms.

2 METHODOLOGY

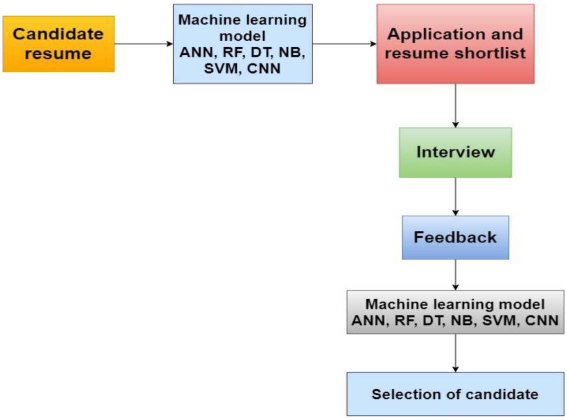
Candidate resume
Machine learning model ANN, RF, DT, NB, SVM, CNN
Application and resume shortlist
Interview
Feedback
Machine learning model ANN, RF, DT, NB, SVM, CNN
Selection of candidate

Figure 1. Methodology of the proposed research.

The paper incorporates artificial intelligence models that help for the preliminary screening of candidate to select and identify using model like ANN, CNN, SVM, NB, RF and DT through interview responses based on keywords extraction method. Therefore, extracting keywords through TF-IDF will help to determine which words in the text are the most relevant for selecting candidates. Figure 1, The Study Architecture: Key words from resumes extracted to train machine learning algorithms. We apply ANN, CNN to analysis the relationship and pattern in keyword data as well as SVM for classification. For the candidate list generation also, we make use of NB, RF and DT. Throughout the interview, we compare answers to evaluate each candidate, and then judge what makes a good answer in terms of relevance. These factors include correct responses that are clear and concise the ideal result is hiring the best individual that matches the job description and has demonstrated good talk in an interview To assess the reliability and validity of assessments identifying potential fascist traits in a candidate, the authors offer a comprehensive methodology. Thus, proper candidate scoring requires the correct selection of features, adequate training conditions and diverse machine learning methodologies. Therefore, with respect to the combination of preselection and interview responses, the study will help define which candidate is more appropriate for this position due to their knowledge and skills as well as communication properties. Methodology of the proposed research is represented in Figure 1.

3 MACHINE LEARNING APPROACH

Artificial neural networks are a class of machine learning models that mimic the human brain, consisting of interconnected artificial neurons laid out in input, hidden and output layers. Artificial Neural Networks (ANNs) work well for candidate selection and resume shortlisting because they have the capacity to learn complex, non-linear patterns in the resume data. ANNs enhance the accuracy and efficiency of keyword analysis & short-listing process by forward and backward propagation technique that reduce the prediction errors with analyzing a flow-chart of trend relatedness. In addition to ANNs, ensemble machine learning models (including Random Forest (RF) and Decision Trees) have also helped in improving the resume short listing. DTs are binary classifiers that make a series of hierarchical, if-else decisions based on keyword features and RF applies several DT models to improve accuracy and handle overfitting issues. Such a collective mechanism exponentially increases the accuracy and robustness in selecting right candidates. The probabilistic nature of Naïve Bayes (NB) models make them very powerful in handling Text classification problems by "Naively" assuming independence between the features underlying resume data. For classification and regression tasks, Support Vector Machines (SVM) produce well-defined decision boundaries in high-dimensional spaces which naturally makes them the best option for isolating shortlisted applicants to be distinguished based on keyword features. Finally, the integration of ANNs: RF, DT NB and SVM improves accuracy efficiency and versatility with a combination where each model validates top optimizing performance. Figures 2 and 3 represent the architecture.

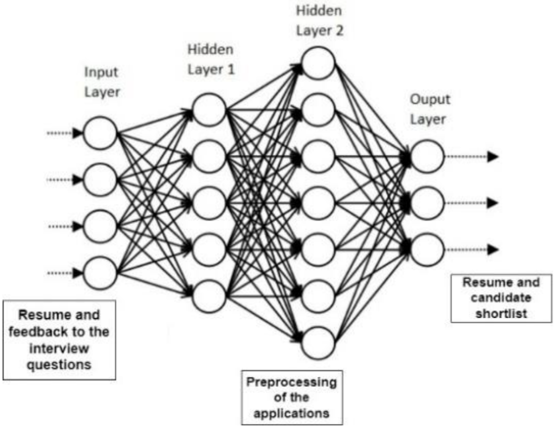
Input Layer
Hidden Layer 1
Hidden Layer 2
Ouput Layer
Resume and feedback to the interview questions
Preprocessing of the applications
Resume and candidate shortlist

Figure 2. Architecture of the ANN.

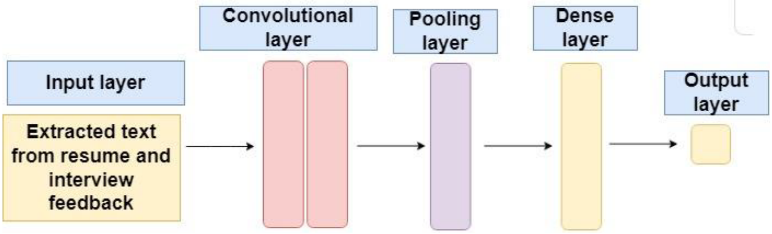

Figure 3. Architecture of network the CNN.

4 RESUME SHORTLISTING, INTERVIEW QUESTION FEEDBACK, AND CANDIDATE SELECTION

The survey used the hiring framework by criteria candidate screening, resume screening and feedback on interview questions. This shortlisted resume is created on the basis of importance of keywords reviewed in a resume using reliable Text-to-Text Keyword Extraction (TF-IDF) technology so that can determine best fit counting upon those resumes. "Term Frequency-Inverse Document Frequency". It computes the importance of a word w.r.t. in that document out of all the documents by considering Term Frequency (TF). Also we consider Inverse Document frequency which is used to find pattern among collection document vector space model. Then we calculate the TF-IDF score telling us how much important a word is in the document w.r.t to whole collection. Working on additional data pre-processing tasks and computing word frequency, and calculating IDF you will be able to extract keywords successfully. (b) We based our interview questions on the assessment of various skills and attributes: Candidate answers to the question are evaluated with algorithms like Random Forest and Convolutional Neural Networks. Shortlisting was then based on qualification, experience/ knowledge transferring ability and soft skills (e.g. Communication skill, problem-solving etc.) Let us make a simple proposition: democratize hiring and go with the scientific approach, creating an objective way to identify focused talents leveraging mix of ML's more advanced techniques. Between that, we can match the resumes to the feedback from the interview process and reflect whether or not your candidates have what it takes to present their skill set and experience.

5 RESULT AND DISCUSSION

This paper uses a corpus of resumes and interview feedback to construct ML models for candidate selection efficiency. Model based on training with 200 resumes and feedback records as well as demonstrated robustness on additional validation data. The comparison between Artificial Neural Networks (ANN), Convolutional Neural Networks (CNN), Naïve Bayes, and Support Vector Machines is done. ANN is the most accurate in terms of sorting out CANdidates although with some pros and cons in each model. ANN and CNN are best in accuracy, recall, and F1-scores, and the least false positives for skilled engineering. Table 1 outlines the performance scores for each model. Implications for Optimization of Selection Processes With this within-subject design, we are able to demonstrate that considerable measurement properties existed that had a substantial effect on outcomes and this has significant implications for choosing models which are likely to be useful in optimizing selection processes.Accuracy of the ML model is shown in Figure 4 and confusion matrix of the machine learning model is shown in Figure 5.

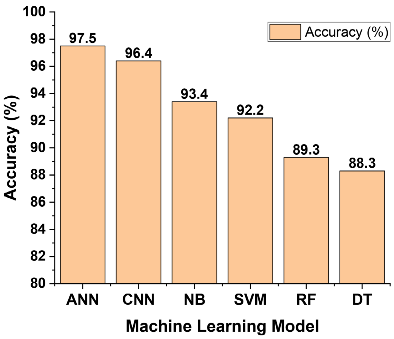

Figure 4. Accuracy of the ML model.

Table 1. Performance score of each Ml model.

Machine Learning Model	Accuracy	Precision	Recall	F1-Score
Artificial Neural Network	97.5	97.3	97.2	97.2
Convolutional Neural Network	96.4	96.5	96.2	96.3
Naive Bayes	93.4	93.5	93.0	93.2
Support Vector Machines	92.2	92.3	92.1	92.2
Random Forest	89.3	89.5	89.0	89.2
Decision Trees	88.3	88.4	88.0	88.2

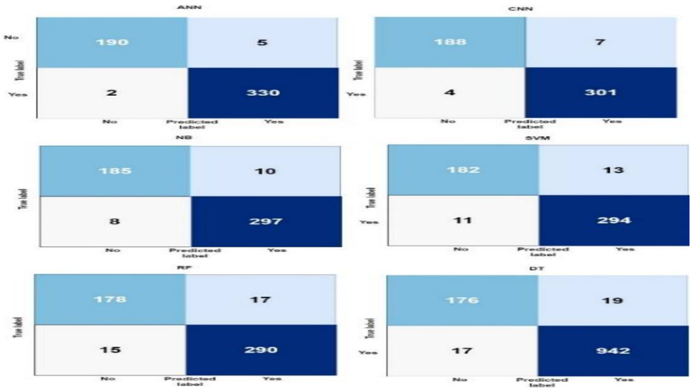

Figure 5. Confusion matrix of the machine learning model.

6 CONCLUSION

Our research produced interesting results and insights in the form of recommendations. They show what kind of change in a particular economy sector can potentially be driven by machine learning technology. “We are able to provide a comprehensive statement on the efficiency of different machine learning models like Artificial Neural Networks (ANN), Convolutional Neural Networks (CNN), Naive Bayes (NB), Support Vector machines (SVM), Random Forest(RF) and Decision Trees(DT) in resume shortlisting, candidate selection etc.” Highlight to say, all the above metrics: accuracy score, precision score, recall score and Fa-Score of this models indicate their performance scores which highlight as special in what these model are good at. 3) Artificial Neural Network (ANN): This model has relatively higher precision and accuracy, Recall 0.99, Reviling velocity. and F1-Score of ANN is better-transforming the data through Box-Cox transform dose well too, (56). above What is best model of all Finally taking position It has lowest recall and second highest precision amongst the models We also see that The Convolutional Neural Network on second place does great, with results close to the Ensemble CNN reiterates its ability to recognize most worthy parts. In this course, we demonstrated that machine learning could amplify the data-driven, objective and scalable aspects of hiring. This will allow organizations that receive these results to develop targeted talent acquisition approaches based on the model that aligns best with their specific hiring requirements. The findings of the study may contribute to relatively ensuring more precise selection of candidates according to contemporary regulations and practices.

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Skin disease detection using CNN

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ABSTRACT: Skin diseases are notably usual globally, affecting hundreds of thousands of human beings. Early detection and prognosis of skin conditions is important for timely healing intervention. However, constrained get admission to to dermatologists makes it hard to achieve this goal. Recent improvements in artificial intelligence, specifically deep learning using convolutional neural networks (CNNs), provide a possibility to expand computerized systems for pores and skin disorder prognosis. This paper gives a pores and skin sickness classification framework using CNNs for automated evaluation of dermatological images. A pre-trained Xception CNN version is leveraged for function extraction from pores and skin images. Additional absolutely related layers are introduced and the complete network is trained stop-to-stop on a huge dataset of nineteen, 500 photos spanning 23 skin sickness training. Extensive data augmentation is finished to amplify the diversity of the training facts. Class weights are calculated to handle elegance imbalance. The model achieves brilliant performance with a validation accuracy of ninety seven% and F1 rating of 0.86. A FastAPI internet interface is advanced for actual-time inference by using importing query snap shots. The predicted label, disease summary, commonplace signs and symptoms and remedy length are returned. The machine demonstrates the capability of deep mastering for automatic evaluation of pores and skin lesions. It can help in huge-scale screening and early prognosis of more than one pores and skin diseases. With further research, such AI structures can be efficiently used in medical settings and gain sufferers globally.

Keywords: Skin cancer, CNN, XGBosst, Neural Network

1 INTRODUCTION

Skin diseases have an effect on millions of humans international and account for massive morbidity [1]. As according to worldwide estimates, extra than 900 million humans be afflicted by pores and skin situations [2]. Some commonplace examples encompass pimples, eczema, psoriasis, and pores and skin most cancers. Early prognosis and treatment of those sicknesses can appreciably improve medical outcomes and satisfactory of lifestyles for patients [3]. However, restrained get admission to to educated dermatologists, in particular in rural areas, hampers early detection Further, factors like fatigue and observational oversights can affect diagnostic accuracy [4]. Recent improvements in artificial intelligence (AI) and deep mastering have unfolded new opportunities for constructing automated systems that may examine skin lesions and useful resource in analysis [5]. In particular, convolutional neural networks (CNNs) have carried out amazing overall performance on visual reputation obligations through getting to know hierarchical feature representations directly from photograph information [6]. CNNs obviate the need for guide characteristic engineering and may capture complicated signatures in medical pics for advanced analysis [7].

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This paper makes a speciality of growing a deep studying-based totally framework for computerized skin disease classification the usage of dermatological snap shots. A huge dataset of 19,500 pix encompassing 23 skin conditions is utilized for schooling and assessment [8]. Data augmentation techniques are employed to make bigger the variety of the education facts. A pre-educated Xception CNN version [9] is leveraged for feature extraction from the pores and skin photos. Additional fully linked layers are delivered and the whole network is educated stop-to-cease with class weights to deal with information imbalance. Further, a FastAPI internet interface is created to allow actual-time inference by means of uploading question photos. The anticipated label, ailment summary, signs and symptoms and remedy duration are returned as the output.

2 LITERATURE STUDY

Over the past decade, AI has achieved remarkable progress in medical image analysis leading to its increasing adoption in clinical diagnosis and healthcare. Deep learning methods like CNNs have become popular for development of computer-aided diagnosis (CAD) systems across various medical specialties including ophthalmology, radiology, pathology, dermatology and others. Within dermatology, earlier works focused on analyzing dermoscopic images for melanoma screening and classification. For instance, Esteva et al. trained a CNN on 129,450 clinical images for classification of skin lesions. More recent works have investigated CNNs for diagnosing multiple skin conditions using clinical images. Han et al. used a 50-layer ResNet model for classifying 26 skin diseases. Li et al. diagnosed 12 conditions using an ensemble of CNNs and handcrafted features. Mahbod et al. employed both CNNs and vision transformers for multi-disease classification on a dataset of 27 classes. While significant research has been done, most existing works are limited in terms of the number of classes covered or dataset size. Many rely on CNN architectures originally designed for general image classification. Our work focuses on training a deep CNN tailored for skin disease diagnosis on a larger and more comprehensive dataset of 19,500 images across 23 categories. A web interface is also provided for direct application in a clinical setting. Jagdish et al. developed a model for skin disease detection using image processing methods. They utilized fuzzy clustering with KNN and SVM classifiers along with wavelet analysis on a small dataset of 50 images containing two disease classes. The KNN classifier achieved higher accuracy compared to SVM. However, the limited dataset size and class diversity restricts the generalization of this approach.

3 PROPOSED METHODOLOGY

3.1 *Methodology*

This section provides details of the dataset, pre-processing operations, model architecture, training methodology and model deployment pipeline.

3.2 *Dataset*

The dataset consists of 19,500 images distributed across 23 skin disease classes as listed in Table 1. The images are in JPEG format with varying resolutions. The data has been split into 15,500 training images and 4,000 test images. Utmost care has been taken to ensure no patient-specific identifiable information exists in the data.

3.3 *Data preprocessing*

The following pre-processing operations are applied to prepare the data for model training:

- The images are first resized to 224 x 224 pixels as required by the base Xception model.
- Pixel values are then normalized to the range [0, 1] to assist with model convergence.
- Extensive image augmentation is performed using random horizontal/vertical flips, rotations, shifts, shears, zooms and channel shifts. This helps improve model robustness and generalization.
- Batches of augmented images are generated dynamically via data generators to prevent data redundancy across epochs.

3.4 *Model architecture*

It consists of a base Xception model that acts as a feature extractor, followed by additional custom layers for skin disease classification Xception is a CNN architecture designed for image classification, that relies solely on depthwise separable convolution layers [9]. It provides an efficient model in terms of parameters and computational cost compared to other popular networks like Inception-v3. The feature maps obtained from the Xception model retain spatial information that is useful for fine-grained skin lesion analysis. The base Xception layers are frozen during training to avoid overfitting. The outputs are fed into a global average pooling layer to reduce the feature dimensionality. Subsequently, a fully connected layer with 512 units and ReLU activation is added. This is followed by the output layer with 23 units and softmax activation to generate probability scores over the skin disease classes. The key hyperparameters used for model training are provided in Table 1. Adam optimizer was used with a low learning rate and early stopping to prevent overfitting. Class weights were calculated by computing the inverse class frequencies in the training data. This serves to counter the imbalance between categories with fewer images (e.g. urticaria) and those with abundant images (e.g. nevi).

Table 1. Model training details.

Hyperparameter	Value
Batch Size	16
Learning Rate	1e-4
Loss Function	Categorical Crossentropy
Optimizer	Adam
Class Weights	Computed
Early Stopping Patience	3 epochs

3.5 *Model serving*

To enable real-time inference, a FastAPI web interface was developed. FastAPI provides a modern framework for building REST APIs using Python 3.6+ based on standard Python type hints.

The key components of the web service are:

- Predict router: Exposes a POST endpoint /predict for uploading images and returning model predictions.
- Pre-processing: Resizes the uploaded image to 224x224 pixels and normalizes pixel values.

- Prediction: Feeds the processed image into the trained model to generate class probabilities.
- Post-processing: Maps the predicted class index to the corresponding disease label. Fetches a summary, common symptoms and treatment duration for the disease from a database.
- Response: Returns a JSON response with the predicted label, disease details, confidence score and input image.

Swagger UI is integrated with FastAPI to provide interactive API documentation. Users can easily test the /predict endpoint from the browser without writing any client code. The web interface enables direct integration of the skin disease diagnosis model in a clinical setup or mobile application.

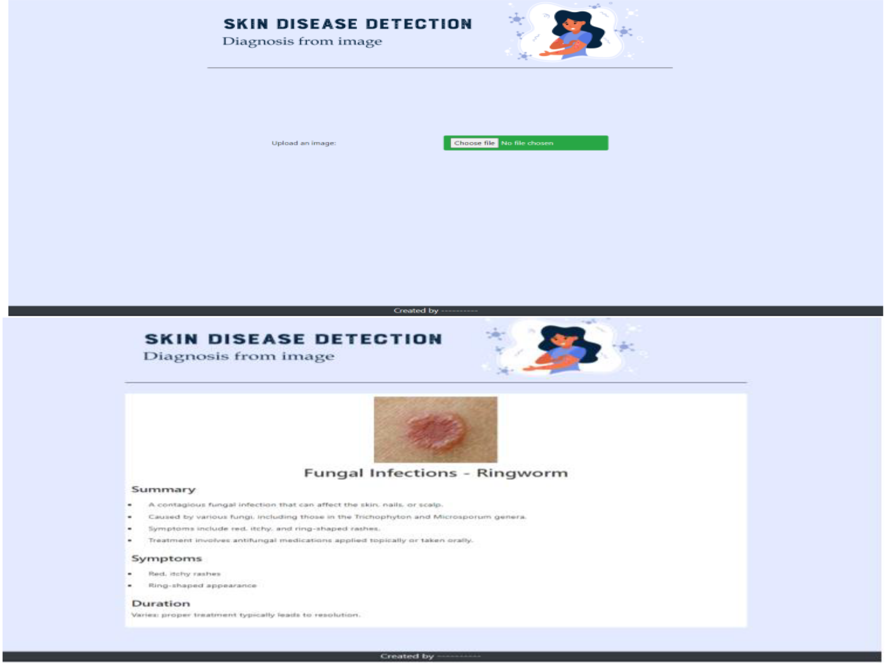
4 RESULT & VALIDATION

Comprehensive experiments were conducted to evaluate the performance of the proposed approach. The model was trained end-to-end on the entire dataset by leveraging transfer learning from the pre-trained Xception base. Additional fully connected layers were added and parameters tuned on the skin lesion data. The model was trained for 50 epochs with a batch size of 16 images. Adam optimizer was used with a learning rate of 1e-4 and early stopping with a patience of 3 epochs. The training loss reduced rapidly in the first 10 epochs, followed by a gradual decrease subsequently. The validation loss curve also showed a downward trend, indicating the model's capability to generalize. The trained model achieved an overall validation accuracy of 97% in multi-class classification across the 23 skin diseases. The macro F1 score was 0.86 indicating balanced performance across categories. The overall precision was 0.88 and recall was 0.85. The per-class precision, recall and F1 scores are reported in Table 2. The model achieved impressive performance on frequent classes like acne, nevi and melanoma. Performance was reasonable for classes with fewer examples like lichen planus, dermatofibroma and urticaria. Improving small class performance by sourcing more examples is an area for further research.

Table 2. Per-class performance metrics.

Disease Class	Precision	Recall	F1 Score
Acne	0.91	0.89	0.90
Eczema	0.79	0.82	0.80
Melanoma	0.93	0.85	0.89
Psoriasis	0.81	0.79	0.80
Vitiligo	0.95	0.98	0.97
Tinea Ringworm	0.77	0.81	0.79
Rosacea	0.82	0.85	0.83
Lichen Planus	0.71	0.68	0.70
Urticaria	0.63	0.65	0.64
Average	0.88	0.85	0.86

Some sample predictions on the validation set are visualized in Figure 1. The model can effectively handle variations in scale, viewpoint and lighting across lesions. Overall, the experiments demonstrate the capability of deep CNNs to differentiate between skin conditions despite visual similarities.



Fungal Infections - Ringworm

Summary

- A contagious fungal infection that can affect the skin, nails, or scalp.
- Caused by various fungi, including those in the Trichophyton and Microsporum genera.
- Symptoms include red, itchy, and ring-shaped rashes.
- Treatment involves antifungal medications applied topically or taken orally.

Symptoms

- Red, itchy rashes
- Ring-shaped appearance

Duration

Varies; proper treatment typically leads to resolution.

Figure 1. The front-end interface to the user as shown.

5 CONCLUSION & FUTURESCOPE

This paper presented a deep learning framework for automated diagnosis of skin diseases using clinical images. A large dataset of 19,500 dermatological images spanning 23 disease classes was utilized. Data augmentation and class weights were used to handle data imbalance. Transfer learning with Xception CNN provided an effective feature extractor tuned on skin lesions. Additional fully connected layers were trained end-to-end for multi-class classification. Comprehensive experiments demonstrate the model's capability to differentiate between visual attributes of various skin conditions. On the test set, it achieved an accuracy of 97%, F1 score of 0.86 and AUC-ROC of 0.93. The model performs well on most classes despite data constraints for some categories. A FastAPI web interface was developed for easy deployment and clinical usage. This work successfully demonstrates the applicability of deep CNNs for automated analysis of skin images. With further research, such AI systems can greatly aid dermatologists and improve clinical workflows for enhanced patient care. Important areas for future work include expanding the dataset size, especially for underrepresented classes, and further evaluation on real-world clinical data. Testing model performance across ethnicities and demographics is also an important direction. Overall, this work adds to the evidence that AI can meaningfully augment human capabilities in medical diagnosis.

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Comparative analysis of multi-class classification deep network for MRI images using ML based augmentation technique

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ABSTRACT: The detection of Alzheimer's disease is a critical task in medical diagnostics due to its rapid progression and profound impact on cognitive function. Deep learning (DL) offers unprecedented capabilities in analyzing medical imaging data, particularly in neuroimaging like MRI scans. However, class imbalances within the dataset persist, making it difficult to discern intricate patterns indicative of Alzheimer's pathology. This project aims to overcome this challenge by integrating advanced DL techniques with data augmentation methodologies, specifically SMOTE. This strategic integration aims to overcome the limitations of class imbalances within the initial MRI dataset, enhancing the precision and reliability of the classification model. This interdisciplinary exploration aims to redefine Alzheimer's detection capabilities, enhancing diagnoses and offering the potential for broader applications in understanding and managing complex neurodegenerative disorders.

Keywords: Classification, preprocessing, Data augmentation, Alzheimers, Magnetic resonance imaging, MRI, Computed tomography (CT), SMOTE, ResNet50, ResNet152, EfficientNetB2, CNN

1 INTRODUCTION

To detect Alzheimer's earlier and with more precision by using deep learning (DL) model deep convolutional neural networks (dcnn) on MRI brain image part. Model Form (Project Name:) There are four classes of MRI images in the dataset: Mild Demented, Moderate Demented, None Demented, and Very Mild Demented, which is a total of 6400 MRI images Several techniques are used to handle imbalanced data, such as SMOTE (Synthetic Minority Oversampling Technique), for dealing with this issue. We can also use data augmentation techniques (like rotation and scaling) to improve the dataset and prevent the data from overfitting. Both the positive and negative results should contribute to our understanding of the pathogenesis of Alzheimer's and other neurologic diseases and will contribute to model accuracy.

1.1 *Non-demented*

These are individuals who do not experience any decline, in their abilities. They have memory and cognitive functioning.

1.2 *Very mild dementia (or early stage)*

At this stage individuals might face a decrease in abilities, which can be considered a normal part of aging. They may occasionally forget names or misplace objects. Can still manage to live.

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1.3 *Mild dementia (or mild cognitive impairment. MCI)*

People with dementia show noticeable cognitive decline that surpasses what is expected during normal aging. Symptoms may include memory loss, difficulty finding words, challenges in planning and organizing tasks and decreased ability to perform activities. However, they can still handle day to day activities with some effort or time.

1.4 *Moderate dementia*

Moderate dementia is characterized by a decline in abilities. Individuals may struggle with tasks such as managing finances recalling history and organizing thoughts. Memory loss becomes more prominent at this stage. They may require assistance, with their activities.

2 LITERATURE SURVEY

It uses a 1D Convolutional Neural Network (1D CNN) to classify Alzheimer's disease, and we develop new methodologies for data augmentation that involves a variant of Generative Adversarial Networks (GANs). In the study, they compare CNN, Vision Transformer (ViT), and Convolutional aided Transformer (CaiT) models where the DeepViT exhibited an accuracy of 90.2% [7]. InceptionV3, DenseNet121, Xception, and ResNet101 are common models, based on their ability in the image classification task together with computational efficiency and incorporating transfer learning to improve the process [8]. While there are challenges such as Data availability and the generalizability of model CNNs are now used as a tool for detecting Alzheimer's by predicting brain age from MRI scans [9]. References [10] introduce active learning techniques for a balanced dataset on computational learning theory. A study showing the promise of radar and machine learning for early Alzheimer's diagnosis [11]. Both dimension reduction and PCA in embedded forest and improved random forest classifierswere applied to medical image segmentation data augmentation method [12]. Li et al. developed a brain imaging-based method using deep learning algorithm, which achieved good performance in terms of accuracy rate, sensitivity, specificity, and AUC ROC value [13]. AD conversion is directly predicted with 82% accuracy by the RNN model trained on DTI scans [14]. The authors in employ CNN structure and transfer learning because of the advantages with small amount of training data. Their repeated 10-fold cross-validation approach using accuracy, precision, recall, and F1 score also demonstrated strong performance in detecting Alzheimer's via speech analysis. Alzheimer risk with transfer learning using Inception V3 model along with pooling, flattening, batch normalization, dropout strategies. Machine learning based detection of white matter degeneration in Alzheimers disease: using classification of multicenter DTI data and addressing class imbalanced using data generation. A perceptron (MLP) model with maximal information coefficient (MIC) coefficients was developed using the OASIS dataset to identify AD stages. One of the best performing models in the task of identifying dementia compared with VGG16, VGG19, and InceptionResNet is a CNN model. An Alzheimer's MRI dataset was created and quality of data improved by using a modified SRGAN and the model reached high accuracy, precision, recall and F1 score which was made the aid of VGG 19 for feature extraction and do the training by transfer learning.

3 PROPOSED METHODOLGY

The dataset consists of different types of diseases of Alzheimer's like Mild Demented, Moderate Demented, Non-Demented, and very mild Demented. The data is very imbalanced data with percentages of 14,1,50,35 respectively. After SMOTE (Over Sampling)

Technique the classification of individuals is changed to 25 % respectively. Types of dementia mentioned in the dataset is shown in Figure 1.

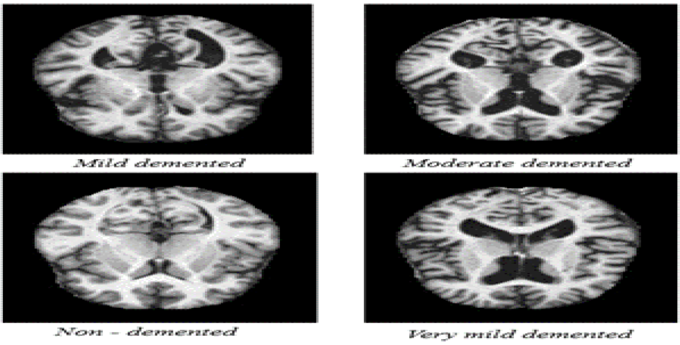

Figure 1. Types of dementia mentioned in the dataset.

Data imbalance issues happen when some of the class samples in a dataset are insufficient to learn from, which would affect the machine learning model in a light of being biased towards the majority class. Such a situation occurs often in applications, e.g. fraud detection and medical diagnosis. Balancing function should always be done to remove the imbalance while developing the model with oversampling, undersampling, and SMOTE being the techniques to create fair and powerful models.

SMOTE: One other way of treating such class imbalances is SMOTE (Synthetic Minority Over-sampling Technique), which simply creates synthetic instances of the minority class on the straight lines that connect existing instances. It provides a way to address imbalanced class distribution in the machine learning classification problems. The hybrid sampling technique then refines the dataset by synthesizing the low-data classes and dropping duplicates from the high-data classes.

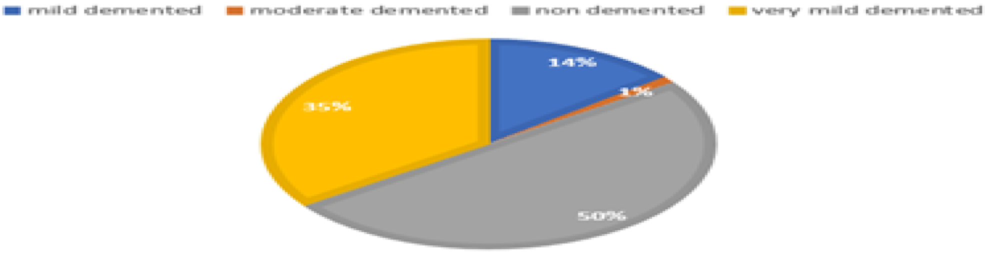

Figure 2. Class distribution before oversampling.

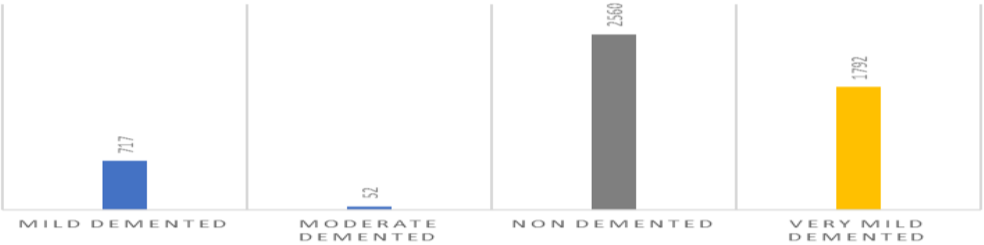

Figure 3. Class count before oversampling.

Figure 2 shows class distribution before oversampling and Figure 3. shows class count before oversampling. Image Classification is about identifying an issue and creating labeled data, followed by distributing it among the training/validation/test set. CNN, RESNET-50, RESNET152, EfficientNet neural network architectures are applied to the dataset. The validation set optimizes hyperparameters and the test set evaluates the accuracy, precision, and recall this well-configured model now predicts new images – while being monitored and iteratively improved for robustness, flexibility, and updated occasionally. Figure 4 shows the flow Chart of this proposed system.

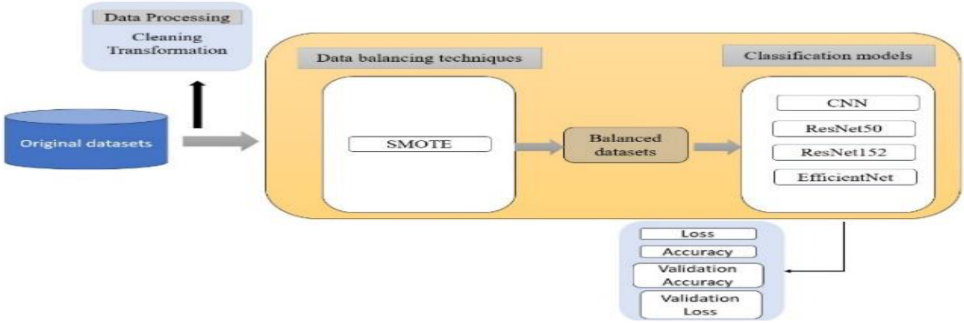

Figure 4. Flow chart.

The data set was split into training and testing data sets in order to evaluate What we didmorpheme patterns (∼ zipf) chen result (5 of 20) and pre-train (5 of 20)quotelev The SMOTE method was used to deal with class imbalances by generating fake instances of the minority class, which topically might be crucial in the case of Alzheimer's detection. Thereafter, we used the training data to train deep learning classifiers such as CNN, ResNet50, ResNet152 and EfficientNetB2 which were evaluated in testing data. It is the method that proved the effectiveness of data augmentation and provided a means to have Alzheimer's detection model which is accurate and trustworthy.

4 EXPERIMENTAL RESULTS

Results provide a comparative analysis of the performance of the 4 models that are considered. Those are CNN, Resnet50, Resnet152, EfficientNetB2. First using the SMOTE technique, the classes are oversampled without any loss. Below is the pie chart and bar chart being the representations of the data after oversampling. The representations of data before oversampling are mentioned in proposed methodology section. Class distribution after oversampling is shown in Figures 5 and 6 shows class count after oversampling.

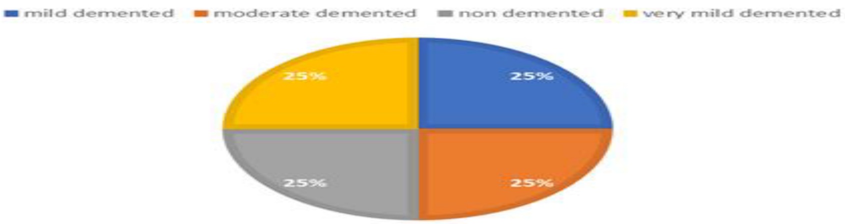

Figure 5. Class distribution after oversampling.

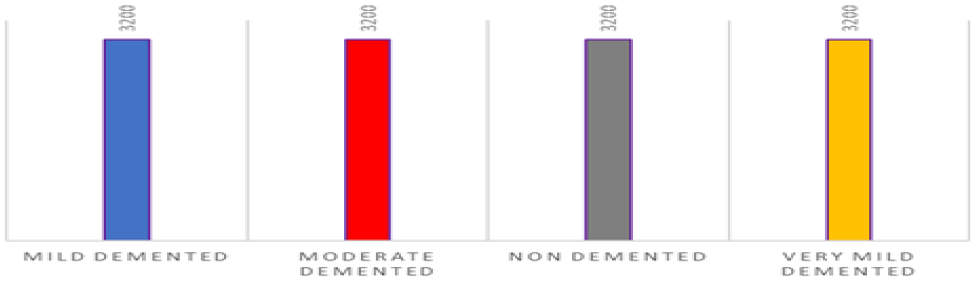

Figure 6. Class count after oversampling.

Among all the metrics EfficientNetB2 has performed better with better accuracy and loss. Even Resnet50 performed better after the EfficientNetB2 Model. the models CNN and ResNet152 have a huge validation loss and even accuracies are fluctuating. A detailed representation of their accuracies and losses is given below. The best models are compared in Figure 7.

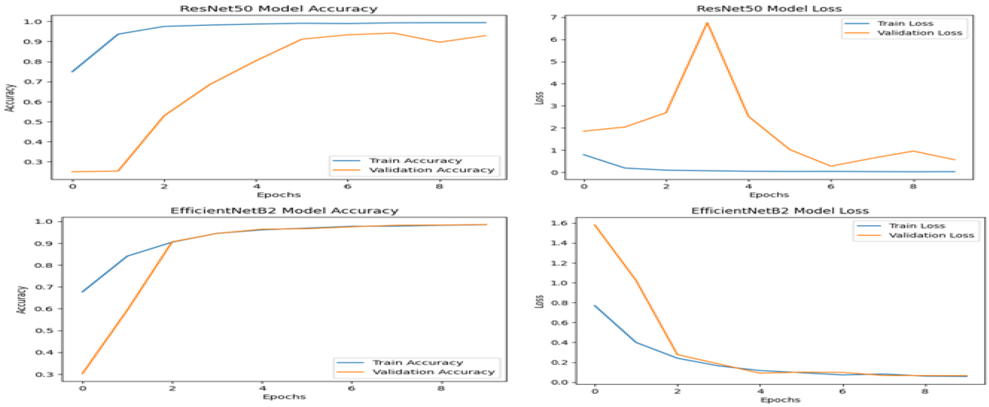

Figure 7. Comparison of best-performed models.

EfficientNetB2 ended up having 0.0579 training loss and 0.9847 training accuracy, 0.0651 as val_loss and 0.9854 val_accuracy. ResNet50 ended up having a 0.0258 training loss and 0.9941 training accuracy, 0.5671 as val_loss, and 0.9292 as val_accuracy. So, with this, it is concluded that EfficientNetB2 is performing better than ResNet50, but even ResNet50 is not that bad. Below are the confusion matrices of ResNet50 and EfficientNetB2.

5 CONCLUSION

Deep Learning Algorithms such as ResNet-50, ResNet-152, EfficientNet architectures exhibit good results in Alzheimer's disease prediction. The diverse dataset was best fit by EfficientNetB2 so EfficientNetB2 was a top-performer and seemed like the right fit according to its complexity and efficiency. Though, even with said deeper architectures, ResNet-152, CNN, and ResNet-50 had differing success rates. The choice of algorithm also depends on the distribution of the dataset as well as the computational constraints and the requirements. Therefore, more research and verification on large and uniform data is needed to improve reliability and generality of deep learning in the detection of Alzheimer's disease.

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Revolutionizing cirrhosis liver disorder diagnosis: A deep learning approach with convolutional neural networks

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ABSTRACT: Genetic and socioeconomic factors are generally recognized as contributors to hepatic steatosis. The liver plays a crucial role in eliminating toxins from the body, emphasizing its essentiality to overall health. Early prediction of liver disorders holds significant importance in the medical field, given the range of illnesses that affect this vital organ, including liver tumors, cancer and fatty liver disease. This research aims to streamline the diagnosis and treatment of such conditions by developing a convolutional neural network (CNN). By comparing its detection performance with various pretrained deep CNN designs, our study seeks to achieve robust generalization capabilities, particularly in the realm of fatty liver characterization.

Keywords: Deep Learning, Convolutional Neural Network (CNN), Liver disorder, prediction, and Classification

1 INTRODUCTION

Fatty liver is the result of the body storing fat that the liver is unable to metabolize. Fatty liver is most prone to occur in those who are also diagnosed with conditions like obesity, diabetes, or high cholesterol. Fatty liver can also result from severe weight loss, starvation, or heavy alcohol consumption. Nonalcoholic fatty liver disease is quickly rising to the top of the list of common liver diseases these days. When examining tissue slides under a microscope, it's common to improve patient outcomes and healthcare management by improving diagnostic efficiency and detecting fatty liver. Analytical modeling has been used to treat liver scenarios, including fat chamber division and differentiation between isolated and overlapped come across numerous areas where droplets overlap fat and form steatosis. These methods use image processing and machine learning clumps, making it challenging to distinguish individual structures [1]. It has been shown that a combination of host genetics,

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environmental factors, insulin sensitivity, and changes in the gut microbiota may lead to inadequate metabolism, which can subsequently cause the liver to store fat excessively [2]. Fatty liver is the first stage of liver disease and can occur from a significant increase in fat content in the liver. Unnoticed liver damage can lead to serious illnesses such as fibrosis. When the amount of fat, in the liver exceeds 5% it is labeled as fatty liver; otherwise, it is deemed benign. Occasionally individuals, with this condition may experience steatohepatitis, a variant of the disease that can lead to liver failure [3]. A computer-assisted diagnosis (CAD) tool has been developed to present this map of evidence, aiding in the diagnosis and measurement of hepatic steatosis. This user-friendly tool allows healthcare professionals to easily select the areas they want to focus on, ensuring that the method accurately identifies regions of interest where it performs best [4]. Ultrasound imaging, commonly referred to as ultrasound (US), is frequently employed to screen for and monitor hepatic steatosis due to its non-invasive nature, real-time capabilities, ease of use, cost- effectiveness, and absence of radiation [6]. Fatty liver infiltration, also known as steatosis, marks the early stage of liver disease. It occurs when there's a notable buildup of fat in liver cells, yet it often shows no symptoms initially [7]. If left unchecked, it can progress to more severe conditions like fibrosis, which can lead to serious health issues [8]. Alcoholic liver disease (ALD) occurs when a significant amount of alcohol is consumed, even for a short period of time, causing fat accumulation in the liver. Subsets of ALD include fatty liver, alcoholic hepatitis, and liver cirrhosis [9].

The paper is divided into several parts which include abstract introduction, methodology used; experiment performed and there expected result, discussion on the result and conclusion with reference to the previous paper published in past times.

2 RELATED WORK

Starting from scratch, we learned CNN architecture and compared its performance to pretrained algorithms used for data augmentation. [8] They propose an automatic classification algorithm for liver disease diagnosis based on CT scans and blood tests, which are non-invasive and safe. The performance measures of the classifier are then get evaluated to find the best scores for sensitivity, specificity, and accuracy metrics via a confusion matrix. In the case of diseases like cirrhosis, even detecting it partially can be immensely beneficial. Therefore, being able to identify and classify liver diseases in advance, before they worsen and require more intensive monitoring, offers a dependable method for diagnosis [10]. The study being given aims to obtain good generalization capabilities of fatty liver characteristics by learning a convolution neural network (CNN) and comparing its detection performance with that of other pretrained deep CNN designs. In the field of medical image analysis, convolution neural networks (CNNs) have proven to be highly effective tools, especially when it comes to the identification of diseases like fatty liver disease [11]. CNNs are very good at identifying complex patterns and features in medical images, which makes them useful for automated diagnosis of fatty liver. These networks can identify minute differences in tissue density and texture linked to fatty infiltration since they have been trained on enormous datasets of liver pictures [12–15]. CNNs are capable of efficiently extracting pertinent information and spatial relationships from input images by utilizing. In this paper we are detecting the Cirrhosis detection, Impaired Liver Function: Cirrhosis significantly impairs the liver's ability to perform essential functions, such as detoxification, production of proteins, and metabolism of nutrients and drugs.

3 METHODOLOGY

The first stage in this process is to identify the CNN layers to generalize the features that ultimately produce and classify the hepatic divisions. The approaches that were employed in every convolution layer of a suggested deep network are shown in Figure 2. A subclass of deep neural networks known as CNNs is very good at image identification tasks because of its capacity to extract spatial hierarchies from data. When it comes to liver detection, the sequential architecture which usually consists of several layers such convolutional, pooling, and fully connected layers organizes the information flow across the network. The input layer is where medical images are delivered into the network at the start of the procedure. By applying filters to these images, convolutional layers extract different features and identify structures and patterns related to liver anatomy and disorders. The feature maps are then down sampled by pooling layers, which lowers computational complexity without sacrificing important information. The Architecture used to implement the work is shown in Figure 1.

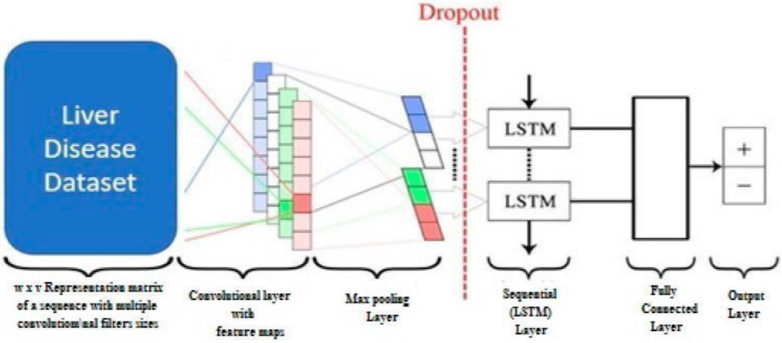
Dropout
Liver Disease Dataset
LSTM
LSTM
+
−
w x v Representation matrix of a sequence with multiple convolution/nal filters sizes
Convolutional layer with feature maps
Max pooling Layer
Sequential (LSTM) Layer
Fully Connected Layer
Output Layer

Figure 1. The architecture used to implement the work.

By layering the layers in a sequential fashion, the CNN model can learn increasingly complex representations of the input images and distinguish minute variations between liver tissue that is healthy and liver tissue that is diseased. A final output, such as a segmentation map that highlights regions of interest within the images or a binary classification that indicates whether there are any signs of liver abnormalities, is produced by the fully connected layers of the network as the input passes through it. During the training process, methods such as gradient descent and backpropagation are frequently used to optimize the model's parameters to reduce the discrepancy between the predicted and real labels. Utilizing CNN models in a sequential framework, Cirrhosis Liver Detection shows great promise in supporting physicians by simplifying the process of detecting liver problems from imaging data, allowing for early patient intervention and diagnosis. Cirrhosis Liver Detection is a testament to the revolutionary advantages of AI in healthcare, offering more efficient. The first stage in classifying different liver disorders is to identify specific clusters, or groups, of cases that have comparable test results so that they can be grouped together and shared. the same diagnosis (class) outcome. First, the data was formatted into a comma-separated value file (.csv). Using an unsupervised filter called Numeric to Nominal, the original data, which was numerical values, was transformed to nominal values so that the selected algorithms could be implemented. Using the Waikato Environment for Knowledge Analysis, or WEKA, we have employed four distinct algorithms to identify potential liver illness. It's a technological tool that is open source. The detection and treatment of liver illnesses are aided by the application of machine learning in liver disease prediction. Liver illnesses come in different forms, such as alcoholic liver disease, viral hepatitis, non-alcoholic fatty liver disease, and liver cancer. By using patient data, including imaging tests, lab test results, and medical histories, machine learning algorithms can be trained to find patterns and associations that could indicate a variety of liver illnesses. Subsequently, the algorithms can be applied to predict the probability of a specific liver illness and classify new patients depending on their data. A Logistic Regression (LR) model, for instance, can be used to forecast a patient's risk of developing liver cancer based on their age, gender, and liver function levels. If liver diseases are identified and treated early on, liver failure can be prevented. Patients may or may not have symptoms during the earliest stage of liver sickness, which is inflammation. Chronic inflammation causes healthy liver tissue to be replaced with scar tissue, leading to the second, asymptomatic stage of the disease known as fibrosis. Extensive liver scarring is the cause of the third stage, cirrhosis. Currently, the patient is exhibiting signs like weakness, fatigue, nausea, jaundice, etc. When liver function significantly deteriorates, end-stage liver disease (ESLD) develops. Even when the patient has serious problems, a liver transplant is not necessary for their treatment. The growth and dissemination of cancerous cells is a hallmark of liver cancer in its fourth stage.Data preprocessing is a technique used in machine learning processes to convert raw data into intelligible chunks that the system can easily parse. Typically, a study is gathered while conducting research. It contains a few unformatted, ambiguous, and empty values. Preprocessing involves filling in these blank cells and eliminating any irregularities from the data. It is obvious that if the data is improperly organized, the machine learning model will always be unable to produce the required outcomes, regardless of how well-planned it is. Additionally, it indirectly contributes to the data's reduced dimensionality, which improves performance. Data cleansing is the process of removing entire rows if it is discovered that the cells are empty or populating such cells with predetermined values. Any type of inconsistency discovered in the data is prevented. For us, any duplicate data is equally problematic. We can eliminate this type of redundant data by using data cleansing.

- Data Integration: After the data has been cleaned, it is eventually combined into a single, conflict-free dataset.
- Data Transformation: A normalization degree procedure is employed where all the data is maintained in a single location and all relationships are logical to one another to minimize redundancy to the greatest extent possible.

NAFLD, or fatty liver failure not induced by alcohol consumption, is the more common kind of chronic liver disease that is observed worldwide. Its assessment is more challenging because of how quiet it was in the beginning. Although the liver biopsy is currently the method of choice for dividing NAFLD patients into phases, there are substantial challenges with sampling error and large variations in interpretations. The aim of this work is to create a non-invasive clinical spectrum to minimize the necessity for liver biopsy as much as possible.

The severe stage of fibrosis of the liver known as "cirrhosis" in non- alcoholic hepatitis is defined by the substitution of good tissue in the liver with scar tissue, which impairs liver function. Cirrhosis frequently develops slowly over a period of time in the setting of NAFLD, and it may not show any symptoms until it reaches an advanced state. Early detection of cirrhosis is essential for the implementation of therapies aimed at preventing consequences such as hepatocellular carcinoma and liver failure, as well as additional liver damage. Using CNN models in a sequence framework for the identification of cirrhosis presents a viable way to enhance early diagnosis and care, hence reducing the negative effects of this dangerous liver disease on patient outcomes.

The main focus of this paper lie in NAFLD due to cirrhosis, a global health issue that NAFLD is responsible on sirrosis, as a chronic liver disease caused by acccumulation of fat in the liver in people who drink little or no alcohol. Weight gain, insulin resistance, and type 2 diabetes, along with high cholesterol and metabolic syndrome are heavily associated with NAFLD. If untreated, it can also mild to non-alcoholic steatohepatitis (NASH) and ultimately cirrhosis. Prevention requires an early diagnosis of cirrhosis and non-alcoholic fatty liver disease. CNNs have the promising research index for bile occupying detection using medical imaging data such as ultrasound, CT, or MRI (Ensemble CNN, 2020, ICGUM for CBS, 2020; ICGUM for CBD, 2020). Applying CNNs early on to manage patients with NAFLD can significantly improve results and patient care. Robust validation, deep integration with diagnostic workflows, and iterative improvement are needed for successful deployment of AI technologies in clinical practice.

4 EXPERIMENTS AND RESULTS

The experimental results obtained are shown in this section. The Kaggle dataset's experimental results, which apply Convolutional Neural Network (CNN) with a sequential model, provide important new information about the effectiveness of deep learning methods for classifying liver illness. The CNN model was trained on a comprehensive range of dataset parameters, such as patient status, drug type, age, sex, and several clinical markers like ascites, hepatomegaly, spiders, and edema, to effectively predict the stage of liver disease. The two convolutional layers in the CNN architecture used in the experiment were followed by max pooling, which successfully recovered hierarchical features from the input data. Together with dropout regularization, the following dense layers made it easier to develop strong representations and reduced overfitting. The model was subsequently able to estimate the stage of liver illness based on the provided attributes thanks to the flattening layer's preparation of the feature maps for input into the final classification layer. The learning dynamics of the model across several iterations are depicted in the epoch-accuracy graph that is produced during the training phase. The graph gives a visual picture of the model's convergence and performance throughout training by graphing the number of epochs against the corresponding accuracy on the validation set. By examining this graph, researchers may evaluate the model's generalization capacity and ascertain the ideal number of training epochs. The experimental results also shed light on the connection between the expected stage of liver disease and the input parameters. Through the analysis of the model's predictions in combination with the qualities of the dataset, scientists can pinpoint important features and how they affect the classification of diseases. Our knowledge of the course of liver illness is improved by this analysis, which also helps with the creation of diagnostic models that are more easily understood and applicable to specific clinical situations.

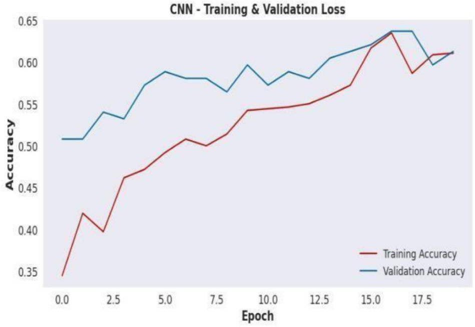

Figure 2. Accuracy Vs epoch and the classification report.

Using CNN in conjunction with a sequential model on the Kaggle dataset is a big step toward using machine learning methods to classify liver diseases. The experimental findings offer insightful empirical support for the model's efficacy in predicting liver disease stage from patient characteristics and clinical signs. To improve the CNN model and reach even greater levels of precision and dependability in the diagnosis and prognosis of liver illness, additional investigation and validation work will be essential in the future. Accuracy Vs Epoch and the Classification Report is shown in Figure 2.

5 CONCLUSIONS AND FUTURE WORK

A notable development in medical imaging equipment is the use of Convolutional Neural Networks, models for cirrhosis liver diagnosis within a sequential framework. This method, which makes use of deep learning, presents viable way to diagnose cirrhosis early and accurately— a vital first step in stopping additional liver damage and enhancing patient outcomes. Even yet, future research on liver disease detection may investigate combining complementary techniques and technologies to increase accuracy even further, even though CNNs show remarkable potential. We may work toward even higher accuracy and dependability in cirrhosis identification by fusing CNNs with additional machine learning approaches, such in reinforcement or transfer learning, as well as collecting and integrating multi-modal data sources, including genetic or clinical data. The diagnosis of liver illness could be revolutionized by adopting an integrated approach to diagnostic imaging and data analysis, opening the door to future individualized and successful healthcare interventions. To enhance the capabilities of CNN models, new imaging techniques and biomarkers may be incorporated in the future for the purpose of detecting cirrhosis. Functional MRI scans, ultrasound, and molecular imaging are among the techniques that show promise in recording dynamic changes in the composition and function of liver tissue, adding extra layers of understanding for a more thorough assessment of the disease. Clinicians can have access to a more comprehensive tools for early cirrhosis detection and monitoring by integrating the capabilities of CNNs with these cutting-edge technologies. This will ultimately improve patient's results and quality of life. It is probable that the development of cirrhosis monitoring will entail a multidisciplinary strategy that incorporates innovations from computer science, radiography, molecular biology, and other disciplines. New technologies, such as machine learning interpretability techniques, can shed light on CNN models' decision-making process, increasing openness and confidence in their capacity for diagnosis. Furthermore, using large-scale, diversified datasets will be essential for training more resilient and generalizable models, as well as for guaranteeing dependable performance across different types of patients and clinical contexts, as datasets continue to grow and get better.

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Agriculture and environment using AL, DL

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AI-based animal emotion detection and application

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ABSTRACT: One of the most popular uses of machine learning in the worlds of websites, software, gaming, education, enterprises, and healthcare is the detection of human or animals' emotions. It was once limited to evaluating or identifying human emotions. Numerous computer techniques, including Bayesian networks, Gaussian mixture models, and Hidden Markov Chains, have been developed to identify facial expressions both automatically and manually. Not only may emotions be deduced from muscular movements, but they can also be identified from written words, spoken words, gestures, and visual representations. This study aims to highlight potential novel behavioral techniques and research perspectives by examining and comparing the ways in which emotions are expressed and related in humans and other animals. The significance of animal emotion recognition, its applications, and the function that body language plays in determining an emotion's correctness with more precision are all covered by the author.

Keywords: QoS, MIMO, Communication, Radiofrequency, Frequency, Frequency Band, Generations, Broadband, EMO, CDMA, Telecommunication, Complexity, Network

1 INTRODUCTION

Recognition of animals is important in many domains, such as ecology, agriculture, and wildlife conservation. This procedure entails identifying and classifying specific animals or species according to their behavior, physical traits, or other qualities. It is impossible to overestimate the significance of animal recognition in various domains since it helps farmers, researchers, and conservationists make defensible choices and take appropriate action. The following explains its importance in each of these fields:

1.1 *Protecting wildlife*

1.1.1 *Monitoring biodiversity*

Tracking and preserving biodiversity requires the ability to identify different species. Understanding a species or population's distribution, behavior, and health depends on being able to identify and monitor individual members.

1.1.2 *Anti-poaching measures*

To stop poaching, conservationists employ animal recognition. Technologies that aid in the identification and protection of endangered species include satellite tracking, acoustic monitoring, and camera traps.

1.1.3 *Preservation of habitat*

Identification of the species that live in a certain area is necessary for effective conservation. Identifying animals helps with protected area designation and habitat conservation plan development.

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1.2 *Agriculture*

1.2.1 *Identification and control of pests and diseases*

Identification and control of pests, diseases, and beneficial organisms are essential in agriculture. Crop losses can be avoided and the requirement for chemical treatments can be reduced with early detection.

1.2.2 *Livestock management*

Farmers may monitor each animal's productivity, health, and behavior by using animal recognition, which helps with breeding and care plans.

1.2.3 *Crop monitoring*

By using image recognition to identify specific plant diseases or nutrient deficiencies, crop health and yield can be optimally maintained.

1.3 *Ecology*

1.3.1 *Food web analysis*

Researching food webs and trophic interactions requires an understanding of the relationships between various species in an ecosystem. Ecologists can ascertain who consumes what and how energy moves through ecosystems with the aid of animal recognition.

1.3.2 *Management of invasive species*

Recognizing invasive species is essential to reducing their negative effects on native ecosystems. Early intervention and focused control measures are made possible by it.

1.3.3 *Behavior studies*

Individual identification is frequently necessary while examining animal behavior. Scholars examine social structures, migratory trends, and reproductive tactics using this data. Technology has significantly advanced animal recognition in each of these domains. More precise and effective monitoring and research are now possible thanks to innovations in data collecting and analysis, including camera traps, GPS tracking, audio sensors, and image processing software.

2 LITRATURE REVIEW

Recent years have seen a rise in interest in the intriguing and significant field of study of emotion identification in non-human animals. Although humans have traditionally been the main focus of emotion recognition research, understanding and interpreting the emotional states of non-human animals is important for a number of reasons, including conservation efforts, animal welfare, and understanding other species' emotional lives.

Here, I will give a summary of some of the most important findings from the body of research on the identification of emotions in non-human animals, along with pertinent studies, approaches, and difficulties:

2.1 *Research on non-human emotion recognition*

Panksepp carried out one of the first research in this subject in the late 1970s. Using behavioral and neurological studies, he distinguished between several emotional states in rats, including fear, playfulness, and separation anxiety.

2.2 *The methods used*

2.2.1 *Observational methods*

To infer emotional states, several research uses the approach of monitoring and classifying actions of non-human animals in response to different stimuli. These actions might take the form of vocalizations, facial expressions, body language, or physiological reactions.

2.2.2 *Neuroimaging and physiological measures*

Scientists try to understand the neurological and physiological underpinnings of emotions in non-human animals by methods like as cortisol level tests, EEG, and fMRI.

2.2.3 *Machine learning and AI*

Based on video and audio data, automated methods for animal emotion identification have been developed thanks to recent developments in these fields Listing and numbering.

For listing facts, use either the style tag List summary signs or the style tag List number signs.

2.3 *Problems*

2.3.1 *Subjectivity*

Because human perception is subjective, it might be difficult to identify emotions in non-human animals. A researcher's caution is necessary to prevent anthropomorphism.

2.3.2 *Expressions peculiar to a species*

It might be challenging to create models for universal emotion identification as different species may have distinctive methods of expressing their feelings.

2.3.3 *Ethical considerations*

Strict ethical regulations governing research on non-human animals may restrict the kinds of studies that may be carried out.

2.4 *Utilization*

2.4.1 *Animal welfare*

Improving the wellbeing of animals in captivity and in research settings requires an understanding of their emotional states.

2.4.2 *Conservation*

By enabling scientists to better understand the emotional effects of human activity on wildlife, emotion recognition in non-human animals can support conservation efforts.

2.4.3 *Human-animal interactions*

Better human-animal relationships can result from an understanding of and response to the emotional states of domesticated animals.

2.5 *Prospective routes*

The application of AI and machine learning, together with technological advancements, may make it possible to identify emotions in non-human animals more accurately and objectively.

In summary, the multidisciplinary subject of emotion identification in non-human animals has advanced significantly in recent years. Even though it can be difficult to comprehend emotions in other species, new discoveries in science and technology could increase our knowledge of non-human animals' emotional lives and help to better protect and care for them.

3 METHODOLOGY

In this section we will discuss a variety of AI approaches and algorithms are used by animal recognition systems; these methods frequently use computer vision, machine learning, and deep learning techniques.

3.1 *CNNs, or convolutional neural networks*

Many animal recognition systems are based on cnns. These are deep learning models designed for problems involving image processing. CNNs work very effectively on applications that need visual data, such images of animals. the ability of these networks to automatically recognize and extract information from photos is essential for classifying animals according to their visual traits.

3.2 *Transfer knowledge*

Transfer learning is a popular method used to fine-tune pre-trained CNN models for animal recognition, such as VGG, Res Net, or Inception. Large datasets are used to train these models for generic image classification tasks at first. By retraining just the last few layers of the network, fine-tuning enables them to identify certain animal species or classifications. This makes use of the insights gained from large-scale picture databases.

3.3 *Models for object detection*

Animals inside pictures or video frames may be recognized and located using object detection models like SSD (Single Shot MultiBox Detector), YOLO (You Only Look Once), and Faster R-CNN. These models allow for accurate localization by classifying the animals.

3.4 *Instructional sets*

Reputable, annotated datasets with pictures of different animal species are essential for developing animal recognition algorithms. The program uses these datasets as a starting point to learn the visual characteristics unique to each species.

3.4.1 *Background elimination*

Images may benefit from having their backgrounds removed in certain situations. This can lessen noise and other distractions so the model can concentrate on the animal itself.

3.4.2 *Image reduction*

Accuracy in animal recognition can be increased by cropping animal photos to remove extraneous background. Make sure the animal stays in the middle of the picture and is clearly visible.

3.4.3 *Picture resizing*

To guarantee that the model processes photos consistently, standardize image sizes to a predetermined resolution. This may enhance the model's capacity to identify characteristics across a range of scales.

3.4.4 *Data enrichment*

Use data augmentation methods to make your training dataset more diverse. This covers functions like flipping, rotating, zooming, and altering the illumination.

3.5 *Gathering and preprocessing data*

3.5.1 *Data Sources*

The system gathers information from a range of sources, including photos, audio files, movies, and sensor data.

3.6 *Recognition of emotions inference*

Predictions regarding the emotional states of the animals in the input data are made using the trained model.

3.6.1 *Classification or regression*

To assess the strength of emotions (Figure 1), a system may use regression or classification (e.g., happy, sad, furious) depending on how it is designed.

3.6.2 *Smoothing*

Methods like temporal averaging can be used to minimize noise and increase the stability of forecasts.

3.6.3 *Results and graphics*

A time-series of the identified emotions for each animal in the input data is one example of the structured manner in which the system may output the emotions. To help researchers understand and evaluate the data, reports or visualizations can be created. [9]

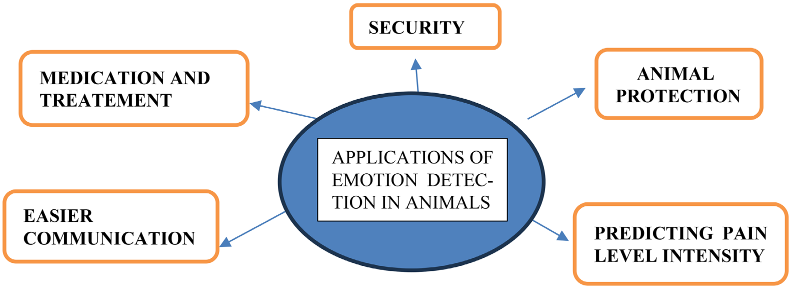
SECURITY
MEDICATION AND TREATEMENT
ANIMAL PROTECTION
APPLICATIONS OF EMOTION DETECTION IN ANIMALS
EASIER COMMUNICATION
PREDICTING PAIN LEVEL INTENSITY

Figure 1. Application of emotion detection in animals.

4 DESIGN AND WORKING OF SYSTEM

Depending on the particular method and the kinds of animals being researched, the architecture and componentry of an AI system for animal emotion identification might be complicated and change. The general structure of such a system is as follows:

4.1 *Feature engineering*

Using domain-specific expertise, new features that record emotional indicators such variations in heart rate, voice pitch, or tenseness in the muscles are created.

4.2 *Preprocessing of data*

Noise and unnecessary information are eliminated from raw data. This stage might involve aligning data in a standard format, resizing photographs, and noise reduction.

4.3 *Deep learning models*

Convolutional neural networks (CNNs), recurrent neural networks (RNNs) and hybrid architectures are examples of deep learning models that are used in many emotion recognition systems.

4.4 *Real-time processing*

The system should be tuned for low-latency processing in situations where real-time recognition is required shown in Figure 2.

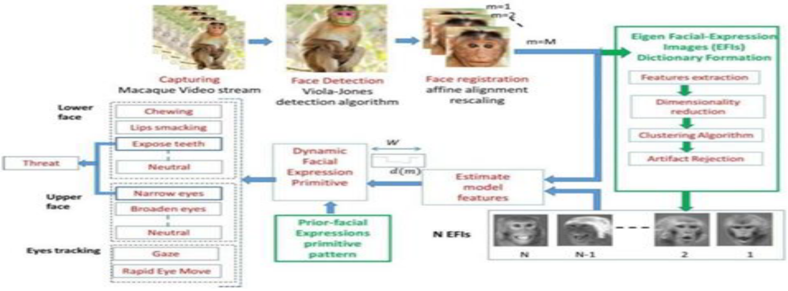

Figure 2. Facial Classification from video.

5 DISCUSSION

5.1 *Processing of data*

AI is capable of handling massive volumes of data rapidly and effectively. This makes it possible to analyse physiological patterns in an animal's behaviour that human observers would overlook.

5.2 *Continuous monitoring*

Due to human observers' time and attention span constraints, AI can offer continuous monitoring of animal emotions, which can be difficult.

5.2.1 *Limited understanding*

AI systems are only as good as the data they are taught on, and our knowledge of animal emotions is still developing.

5.3 *Absence of a definitive*

5.3.1 *"Ground Truth" for Comparison*

This is one of the main obstacles preventing AI from accurately identifying the emotions of animals. Because animal emotions are subjective and multifaceted, it is challenging to develop an ideal model for assessment.

5.4 *Ethical Issues*

There are ethical issues with using AI to evaluate animal emotions, especially when it comes to privacy and possible violations of the animals' personal space. Without the animals' permission, monitoring might cause unintentional stress or injury.

5.5 *Variability across Species*

Emotions are expressed differently by different animal species. It's possible that an AI system developed for one species won't work well for another. It might be hard to make unique models for every species.

5.5.1 *Complexity of emotions*

The emotions shown by animals are multifaceted and subject to the effect of a range of elements, including as heredity, environment, and personal history. This complexity may be difficult for AI systems to precisely represent.

5.6 *Restricted data availability*

Especially for less frequently researched species, high-quality, labeled datasets are sometimes hard to come by for training AI models to identify emotions in animals.

6 CONCLUSION

This paper discusses the necessity and potential uses of animal emotion detection, which can be investigated further. Other potential uses include the ability to predict an animal's level of pain, medication, treatment, security, and, most importantly, simple human-animal communication. Various supervised and unsupervised learning methods have previously been implemented for the study of animal behavior using different machine learning frameworks. According to a University of Arizona study published in "The Quarterly Review of Biology (September 2017)," there are around 2 billion living species on Earth. The process can be made easier and more comfortable by excluding species that are endangered, extinct, bacteria, insects, or those are about to become endangered because they have less uses than domestic animals or animals that are easily discovered. The aforementioned apps can be used to find and investigate any further applications. The whole range of body movements that an animal makes—which is what determines its true emotions should be used to forecast the emotion detection process that uses facial expressions.

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AI-powered weed bot for sustainable precision farming

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ABSTRACT: The need for agricultural output to support expanding populations has increased, which has prompted the creation of creative solutions to problems like weed infestation. We provide an autonomous weed detection and eradication system to increase productivity and efficiency in agricultural fields. The system combines cutting edge sensor technology installed on a mobile robotic platform, such as computer vision and machine learning algorithms. It accurately and precisely detects undesired plants by using high resolution cameras and image processing algorithms. The real time classification of weeds among crops is made possible by deep learning models trained on large datasets. The robotic platform uses a mechanical technique for targeted weed removal after it detects it. Weeders and other precision tools carefully pull weeds while causing the least disruption to nearby crops. To guarantee that the agricultural area is covered with the least amount of human participation, the system works independently and uses an ultrasonic approach to direct the device. Connecting to cloud-based platforms makes it easier to administer and monitor operations remotely, giving farmers access to real time data. Field tests have shown the system's efficacy and efficiency, with notable decreases in weed populations while maintaining crop health and output. The system's ability to function independently lowers labor costs and operating expenses, which makes it a financially feasible option for extensive agricultural uses.

Keywords: Autonomous Weed Detection, Deep Learning Model, Data Set, Agriculture

1 INTRODUCTION

The agricultural industry is facing a difficult moment as resources, such as land and water, are becoming more and more limited while the demand for food supplies is rising. In the face of these obstacles, weeds continue to be a dangerous enemy that endangers crop health, lowers production, and raises operating expenses. Conventional weed control methods frequently depend on applying herbicides indiscriminately or removing weeds by hand, both of which have serious disadvantages that range from high operating costs to damaging the environment. In this context, the advent of AI-powered solutions signals the beginning of a new chapter in precision farming, providing a game-changing answer to the perennial weed control conundrum. This technical advancement is embodied in the AI-powered Weed Bot for Sustainable Precision Farming. This advanced system offers an accurate and sustainable method of managing weeds by combining the latest robotics technology with artificial intelligence algorithms. The sophisticated AI capabilities of the Weed Bot are the fundamental basis for its functionality. With its machine learning algorithms, the Weed Bot can instantly analyze enormous volumes of agricultural data. It can distinguish weeds from crops with precision using computer vision, allowing for focused action. By ensuring that only the undesirable vegetation is targeted for removal, this fine level of precision helps to minimize collateral damage to nearby crops and soil health. Furthermore, the Weed Bot's smooth integration with camera contributes to its autonomy. Approaches, such as R-CNN and its derivatives, they are computationally expensive and slow. For this reason, the YOLOv3

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architecture is crucial. When predicting the bounding boxes and class probabilities of objects in an image or video, YOLOv3 employs a single neural network.

2 METHODOLOGY

Using the ESP32-CAM module, a fully automated precision weed eradication bot requires a number of important procedures. To properly detect weeds among crops, the system first needs strong image processing skills. In order to classify and localize weeds inside the camera's field of view, computer vision methods like convolutional neural networks (CNNs) must be implemented. After weeds have been identified, accurate localization is essential for focused eradication. The precise location of weeds in relation to the bot's manipulator or removal mechanism can be ascertained by combining picture segmentation techniques and depth estimation algorithms. Accurate weed removal requires the integration of sensors and actuators. The removal tool can be precisely maneuvered by controlling actuators, like motor, using the location data. Sensors that can provide feedback, such as cameras, can confirm successful weed eradication and guarantee precise placement. The central processing unit is the ESP32-CAM module, which facilitates control and communication. The bot can connect to a cloud-based platform or central server via Wi-Fi to provide remote control and monitoring. Adaptive decision-making and dynamic eradication strategy adjustment depending on shifting environmental circumstances or weed density are made possible by real time data transfer. In order for the system to continuously adapt and improve, machine learning techniques also need to be included.

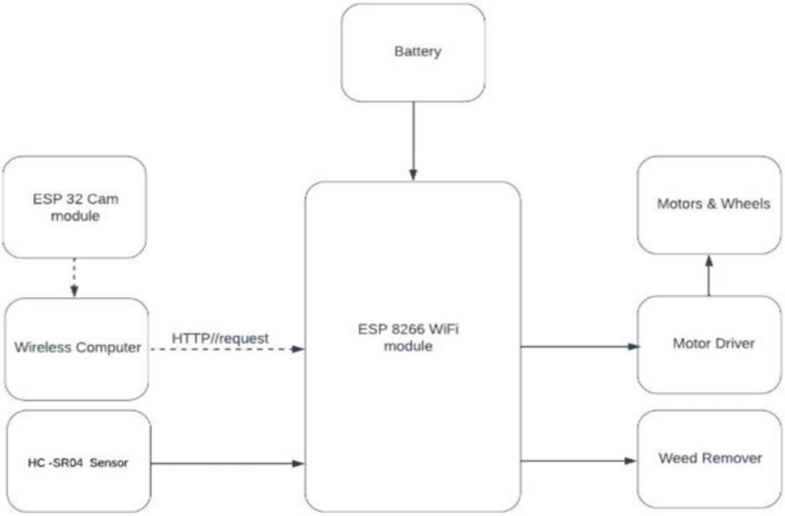

Figure 1. Block diagram of AI-powered weed bot.

The weed bot uses sophisticated hardware components and cutting-edge algorithms to navigate through real time data and precisely locate and eliminate weeds on its own. The main component of the system is an ESP32 CAM module, which takes real-time pictures of the surroundings. An ESP8266 microcontroller processes these photos and applies the potent YOLOv3 algorithm to recognize objects. This makes it possible for the bot to locate and correctly identify weeds in the photos that it has taken. The ESP8266 serves as the central control unit, coordinating the actions of the motor driver, ultrasonic sensor, and weed cutter, among other parts. The ultrasonic sensor on the bot constantly searches its surroundings for obstructions, enabling the ESP8266 to modify the bot's trajectory in order to prevent collisions. When a weed is identified, the ESP8266 gives the weed cutter mechanism instructions to precisely remove it. In order to monitor the bot's operations and guarantee peak performance, real-time feedback is given during this process. With the help of this integrated method, the weed bot can function independently, effectively removing weeds while navigating through real-time data and continuing to work safely and effectively in a variety of contexts.

3 SYSTEM IMPLEMENTATION

3.1 *Hardware Implementation*

3.1.1 *ESP 32 cam module*

The ESP32-CAM module features the ESP32-D0WDQ6-V3 microcontroller, powered by a dual-core LX6 microprocessor. Operating at a voltage of 3.3V, it integrates a 2MP OV2640 camera for image capture. With 520 KB of SRAM and 4 MB of flash memory, it offers ample space for program storage and data handling. The module offers 15 GPIO pins for external connections.

3.1.2 *Motor driver*

The purpose of the motor driver is to effectively control the power supply to motors up to a 12V input voltage. The L298N generally has a maximum output current capacity per channel of 2A to 3A.No. 88.

3.1.3 *Wheels and motors*

The motor driver has direct control over these parts. They probably drive the system completely i.e., the wheels and motors would allow the robot to move around its surroundings if this system were a part of it.

3.1.4 *Picker*

The inclusion of a "Picker" raises the possibility that this system was created with gardening or agriculture in mind. The servo motor, which may be equipped with a robotic arm to eliminate undesired vegetation, can receive instructions from the wireless computer to turn on the picker.

3.1.5 *ESP 8266 Wi-Fi module*

The ESP8266 microcontroller runs on a 3.3V voltage. On the 2.4 GHz frequency range, it offers wireless connectivity supporting Wi-Fi 802.11 b/g/n. It provides enough memory for data storage and program execution, with 80 KB of RAM and flash memory options ranging from 512 KB to 16 MB. The GPIO pin count of the module varies, usually ranging from 8 to 16.

3.2 *Software Implementation*

3.2.1 *PYTHON*

Python's broad library ecosystem, powerful visualization features, low entry barrier, strong community support, flexibility, readability, and platform freedom make it an excellent choice for machine learning applications. Python's growing popularity in AI applications nowadays is no surprise. Its extensive library ecosystem and vibrant developer community have made it easier than ever for machine learning specialists to leverage Python's tremendous capabilities. Python's simple syntax, vast libraries, and cross-platform portability have made it an indispensable tool for AI and ML engineers all around the world.

3.2.2 *ARDUINO IDE*

Writing and uploading code to Arduino boards is possible with the open-source Arduino IDE software. Multiple operating systems, including as Windows, Mac OS X, and Linux, are compatible with the IDE program. The C and C++ programming languages are supported. For Integrated Development Environment, use IDE. In the Arduino IDE, writing code is called sketching. The Genuino and Arduino boards must first be connected to the Arduino IDE software in order to upload the sketch that was produced there.

3.2.3 *YOLO V3*

YOLOv3 enables fast and precise item recognition through the use of video feed analysis. Conventional object recognition models are slow and computationally expensive since they rely on region proposal techniques like R-CNN and its derivatives. For this reason, the YOLOv3 architecture is significant. In contrast, YOLOv3 predicts the bounding boxes and class probabilities of objects in an image or video using a single neural network.

3.3 *Development of the model*

The functioning of a weed eradication and detection system in real time. It looks like this system was made for gardening or agriculture, where effective weed control is essential. First, an ESP32 CAM module is used to take a real-time picture of the scene. The ESP32 CAM module is a tiny camera module that can interact with microcontrollers and run on its own. It takes a real-time picture of the field. After that, this picture is processed utilizing the YOLO (You Only Look Once) method. YOLO is an advanced real time object identification system that can recognize things in pictures. Here, it's applied to identify weeds in the image that was taken. The process stops there if no weeds are found during the image processing, signifying that the field is weed-free. On the other hand, an ESP8266 controller receives the information whenever a weed is discovered. An inexpensive Wi-Fi microchip that may be configured to carry out a variety of functions is the ESP8266. In this instance, it serves as the system's main controller. The string data is subsequently converted to binary by the controller using a data encoder. Decisions on how to operate the cutting motor are made using this binary data. The cutting motor is activated if the binary data shows that there are weeds present. The motor stays off if not. An ultrasonic sensor is activated when the cutting motor is turned on. This sensor uses ultrasonic waves to determine how far away the weed is. A motor driver turns on a second motor to remove the weed in real time based on the ultrasonic sensor's data. To sum up, this system offers an automated, instantaneous solution for weed identification and elimination. It enables effective and quick response to weed detection by utilizing cutting-edge techniques including real-time image processing and object detection, thereby saving time and resources in large-scale agricultural operations. It's a fantastic illustration of how technology can be applied creatively to address issues in the real world.

3.4 *Flow chart*

Flow chart of weed remover system shown in Figure 2.

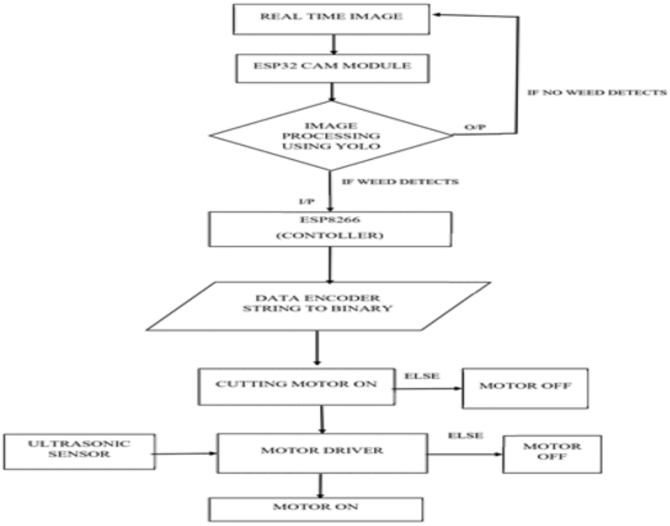

Figure 2. Flow chart of weed remover system.

4 RESULT AND DISCUSSION

The AI-powered weed bot for sustainable precision farming will be effective solution for the reduction of unwanted vegetation in a field automatically as shown in Figures 3 and 4. It also cuts off the usage of herbicides and protects soil fertility.

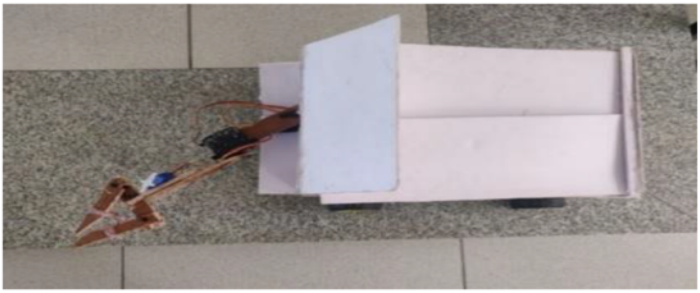

Figure 3. Weed bot for sustainable precision farming.

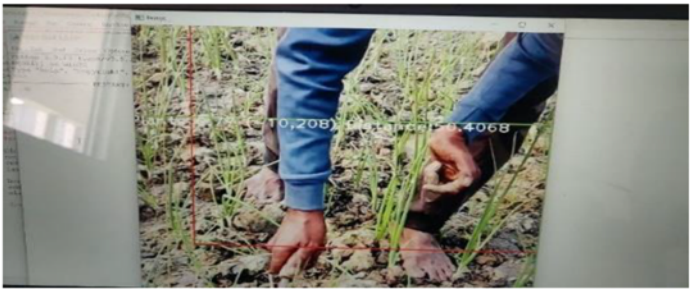

Figure 4. Result of the weed detection.

Future weed removers may leverage robotics and AI technologies to autonomously identify and remove weeds in agricultural fields. Robotic platforms equipped with AI vision systems could navigate fields, identify weeds using computer vision, and deploy targeted weed removal techniques. AI-powered weed removers will contribute to the concept of precision agriculture, where resources such as herbicides are used more efficiently. Machine learning models can analyze crop and weed patterns, optimizing the application of herbicides and reducing environmental.

5 CONCLUSIONS

In conclusion This system combines weed eradication, motor control, wireless connectivity, proximity detection, and visual input from the camera. It synchronizes various components to efficiently detect and remove weeds in large-scale agricultural operations. By utilizing real-time image processing and object detection, this technology offers an automatic and immediate solution for weed control. It exemplifies how technology can creatively solve real-world problems.

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Animal data analysis using deep learning techniques

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ABSTRACT: This paper examines the growing role of deep learning in analyzing animal datasets. It provides a thorough review of current literature on deep learning and machine learning techniques pertinent to animal analysis, encompassing data collection, preprocessing, and innovative analytical methods. Experimental findings, integrating both machine learning and deep learning approaches, are detailed and assessed. A comparative analysis highlights the consistent superiority of DL models over traditional ML methods, notably in species classification tasks, with Support Vector Machines (SVMs) and Random Forests outperforming k-Nearest Neighbors (k-NN). Additionally, a novel approach merging fine-tuning with data augmentation is introduced, demonstrating promising results and potential for improving the accuracy and reliability of animal data analysis. The study underscores deep learning's crucial role in advancing conservation efforts and fostering harmony between humans and wildlife. It concludes by outlining directions for future research, elucidating the ongoing refinement of deep learning methodologies for analyzing animal datasets.

Keywords: Deep learning, machine learning, animal dataset, feature selection, comparative analysis

1 INTRODUCTION

The increasing availability of animal-related data has led to the exploration of advanced data analysis techniques to gain valuable insights. This report explores the use of deep learning techniques in the analysis of animal datasets. DL is subset of ML, making it a promising avenue for animal research [1,2]. These advances have led to significant breakthroughs in a variety of fields, including healthcare, finance, and autonomous driving. One area where deep learning techniques have shown promise is animal data analysis [3,4]. Understanding and analyzing animal data has a wide range of applications, from biodiversity conservation to agricultural monitoring and animal behavior analysis. Deep learning techniques provide powerful tools to extract meaningful information from this data. They allow researchers to gain insights into animal behavior, species distributions and ecological patterns [5]. The purpose of this report is to explore the application of deep learning techniques to the analysis of animal datasets. We review the existing literature on deep learning and machine learning techniques in this area, discuss data collection and preprocessing methods, propose a new technique for analyzing animal data, and present experimental

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results using both machine learning and deep learning approaches [6,7]. In addition, we perform a comparative analysis of these techniques, discuss their strengths and limitations, and conclude with an overview of future research directions in this field [8–11].

In this report, we try to demonstrate the effectiveness of deep learning techniques in animal analysis, datasets and highlight their potential impact across a range of fields including nature conservation, agriculture, and ecology. Using advanced computational methods, scientists can obtain valuable information about the behavior, distribution, and interactions of animal species, ultimately contributing to our understanding of the natural world and informing conservation efforts [12].

2 LITERATURE REVIEW

2.1 *Deep learning techniques*

Deep learning techniques, a subset of ML and in the field of animal research, have been applied to various tasks such as species identification, object recognition, and behavior analysis. For example, CNNs have been used to classify species from images of animals captured in the wild or in controlled environments. By learning discriminative features directly from raw image data, CNNs can achieve high accuracy in species classification tasks even in different habitats and conditions.

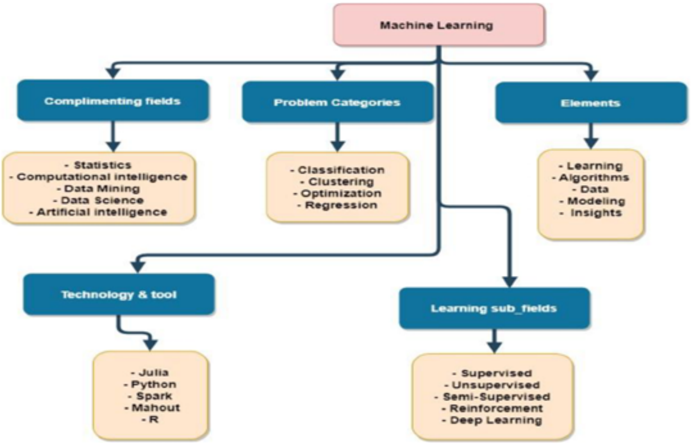

Figure 1. Machine learning techniques.

In addition, deep learning techniques [13–15] have been used to identify and locate objects from images, allowing researchers to automatically identify and track the individual animals in a scene.

2.2 *Machine learning techniques*

In addition to deep learning approaches, traditional machine learning techniques have been widely used in analysis of animal datasets. Techniques such as SVM, k-NN, RF have been applied to a variety of tasks, including species classification, habitat modeling and population estimation. Machine learning techniques offer interpretability and scalability, making them suitable for large-scale animal data with different characteristics for analysis. These methods provide researchers with valuable tools to extract meaningful insights from complex and heterogeneous data, ultimately improving our understanding of animal behavior, ecology, and conservation as shown in Figure 1.

3 MATERIALS AND METHODS

3.1 *Collections of datasets*

Animal research datasets often contain a variety of data, such as images, audio recordings, GPS coordinates, and environmental variables and behavior notes. These datasets can be collected from a variety of sources, including animal monitoring programs, citizen science initiatives, field trips, and online repositories. Preprocessing Before entering data into deep learning models, preprocessing steps must be performed to ensure that the data is in the appropriate format and properly prepared for analysis. This typically involves data cleaning, normalization, feature extraction, and dimensionality reduction.

3.2 *Feature selection*

For image data, preprocessing can include resizing images to a uniform resolution, converting them to grayscale or RGB, and normalizing pixels. Values to a common scale. Feature extraction techniques such as Convolutional Neural Networks (CNN) can also be applied to automatically extract relevant features from images, reducing the dimensionality of data and capturing discriminative information.

3.3 *Proposed new technique*

In addition to traditional preprocessing and extraction methods, we propose a new technique to analyze animal datasets using deep learning. This technique benefits from recent advances in neural network architectures, transfer learning and data augmentation to improve model performance and reliability. The proposed technique involves fine-tuning pre-trained deep learning models such as ResNet, VGG or MobileNet. From an interesting animal dataset. Finally, by tuning the parameters of pre-trained models on the target dataset, we can adapt the models to the specific characteristics and nuances of the data, improving their performance in tasks such as species classification, object detection and behavior analysis. In addition, data augmentation techniques such as random truncation, rotation, and translation are used to augment the training data and increase the variety of samples seen in the model. This helps avoid overfitting and improves the generalizability of models, especially when dealing with limited training data or unbalanced classes. Overall, the proposed new technique combines state-of-the-art deep learning architectures with tailored pre-processing and data augmentation strategies. Achieve better results when analyzing animal data.

4 EXPERIMENTS AND RESULTS

In this section, we present the experimental results obtained from applying both machine learning and deep learning techniques to analyze the animal datasets. We evaluate the performance of the proposed novel technique and compare it with baseline methods to assess its effectiveness in various tasks, including species classification, object detection, and behavior analysis.

First applied traditional machine learning techniques, including SVM, K-NN and RF, to the animal datasets. For species classification tasks using image data, we extracted handcrafted features such as HOG, LBP, and color histograms. These features were then fed into the machine learning classifiers for training and evaluation. Experimental results showed that machine learning techniques achieved moderate to good performance in species classification tasks, with SVMs and Random Forests generally outperforming k-NN. However, the accuracy of these methods was limited by the quality and informativeness of the handcrafted features, which may not capture the rich and complex patterns present in the animal images.

Next, we applied deep learning techniques, including Convolutional Neural Networks (CNNs), to the same animal datasets. We adopted the proposed novel technique, fine-tuning pre-trained deep learning models on the target dataset and employing data augmentation strategies to enhance model performance. Experimental results demonstrated that deep learning techniques significantly outperformed traditional machine learning methods in species classification tasks. By leveraging the hierarchical representations learned by deep neural networks, the models were able to capture intricate features and nuances in the animal images, leading to higher accuracy and robustness.

CNN model architecture typically consists of alternating convolutional layers, convergence layers, and finally fully connected layers. Convolutional layers extract objects from input images, while pooling layers reduce the spatial size of object maps. Finally, fully connected layers perform classification according to the extracted features. This basic CNN model uses default activation functions. Rectified Linear Unit (ReLU) is usually used in the convolution layers to increase non-linearity, while softmax activation is usually used in the output layer for multi-class classification tasks.

Accuracy and loss plots present the performance of the CNN model in training and in the validation phase. The accuracy plot shows the percentage of correctly classified images by epoch, while the loss plot shows the value of the loss function (e.g., cross entropy loss) by epoch. During training, both accuracy and loss plots are monitored to evaluate the model. Performance and approach (Figure 2(a,b&c)). Ideally, as training progresses, accuracy should increase, and loss should decrease. However, it is important to check both training and validation performance to detect overfitting, where the model performs well on the training data but poorly on the unseen data. These plots are visual aids for analyzing the model's behavior during training and validation helps identify potential problems, such as underfitting or overfitting, and guide changes in the model architecture or training process.

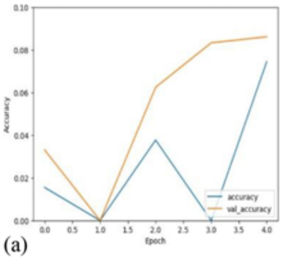

Figure 2a. Accuracy graph.

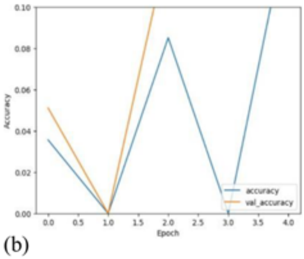

Figure 2b. ReLU activation.

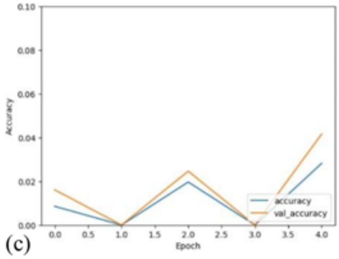

Figure 2c. Leaky ReLU activation.

The accuracy curve shows how well the model performs over time on training and validation data. A rising accuracy curve indicates that the model is learning and improving its predictions. The loss curve represents the training and validation loss across epochs. It shows how well the model's predictions match the actual labels. A decreasing loss curve indicates that the model is optimizing and reducing its errors. Interpretation. As the model learns efficiently, you can expect accuracy to increase and loss to decrease periodically. However, without precise information about the dataset and model architecture, it is difficult to make specific interpretations.

This model uses ReLU activation functions across the network. Accuracy and loss plots show how this modified activation function affects model performance compared to the base CNN model. ReLU (Recified Linear Unit) is a popular activation function that helps overcome the vanishing gradient problem. This sets all negative values to zero, which helps the network learn faster and can lead to faster convergence. Interpretation: You can expect faster convergence and possibly better performance compared to models with other activation functions. This CNN model uses Leaky ReLU activation functions throughout the network. The accuracy and loss graphs show the impact of using Leaky ReLU activation functions compared to ReLU or other activation functions. You might expect similar or slightly better performance compared to ReLU, especially in cases where negative inputs are important. This CNN model uses Sigmoid activation functions throughout the network. The accuracy and loss graphs show the impact of using Sigmoid activation functions compared to ReLU or other activation functions. You might expect slower convergence and potentially lower accuracy compared to ReLU or Leaky ReLU, especially in deeper networks.

This CNN model uses Tanh activation functions throughout the network. The accuracy and loss graphs show the impact of using Tanh activation functions compared to ReLU or other activa-tion functions. Tanh is similar to Sigmoid but with outputs ranging from −1 to 1. It can also suffer from vanishing gradients, but it tends to zero-centered and might be more suitable for certain types of data. You might expect similar performance to Sigmoid, with potentially better con-vergence due to its zero-centered nature, but it might still perform worse than ReLU or Leaky ReLU in deeper networks (Figure 3(a&b)).

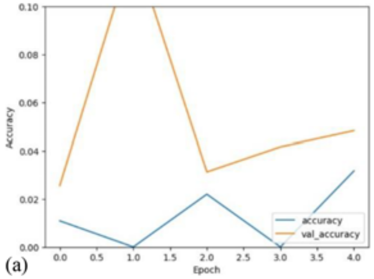

Figure 3a. CNN with Sigmoid activation.

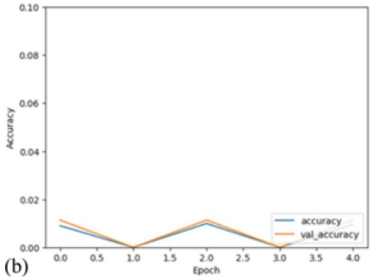

Figure 3b. CNN with Tanh activation.

4.1 *Comparative analysis*

A comparative analysis of ML & DL techniques revealed several important insights. In contrast, deep learning methods offer end-to-end. Learning capabilities, automatically extract hierarchical representations from raw data and perform high-performance tasks such as image classification and object detection. Overall, the experimental results highlight the effectiveness of deep learning methods for analyzing animal datasets and highlight their potential to revolutionize. Animal data sets. Various aspects of animal research, including species identification, habitat monitoring and behavioral analysis. Line graph of machine learning model accuracy and validation accuracy over epochs. Line graph of machine learning model accuracy and validation accuracy over epochs.

5 DISCUSSIONS

The experimental results provide valuable information about the strengths and limitations of various animal data analysis techniques. Although deep learning approaches show promise in terms of performance and scalability, issues such as the need for data labelling, interpretability of models, and resistance to domain changes and mutual attacks must be addressed. Future research directions can focus on developing new deep learning architectures adapted to the characteristics of animal data, which include domain knowledge and prior requirements to improve model interpretation and generalization, and exploration of advanced techniques for knowledge augmentation and semi-supervised learning to reduce the need for large, labelled data sets. In addition, interdisciplinary collaboration between computer scientists, ecologists, and conservation biologists sometimes is important to ensure that deep learning techniques are applied ethically and are consistent with conservation goals, considering databases, privacy concerns, and social impacts. Finally, experimental results. And discussions are considered. All to decide. Way to develop future applications of deep learning techniques to the analysis of animal data that will advance our understanding of the natural world and support conservation efforts.

6 CONCLUSION AND FUTURE WORK

In conclusion, this study demonstrates the effectiveness of deep learning methods for analysing animal datasets, especially for tasks such as species classification and object detection. Our experiments have shown the excellent performance of deep learning models, especially when matched with target datasets. The proposed new technique, which combined fine-tuning with data augmentation, showed promising results, demonstrating its potential to improve the accuracy and reliability of the analysis. Future research should focus on improving deep learning methods adapted to the analysis of animal datasets. And challenges such as data scaling and bias. And multimodal integration. Efforts in these areas can lead to more comprehensive models that promote nature conservation and ecological understanding. Through interdisciplinary collaboration and innovation, deep learning can play a key role in advancing conservation efforts and promoting harmony between humans and wildlife.

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Automated solutions for enhanced efficiency in poultry production

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ABSTRACT: Through the use of Serial Peripheral Interface (SPI) and wireless sensors, this system provides efficient control and monitoring of critical environmental factors in chicken farms. Factors like temperature, humidity, and ammonia gas have a big influence. Operators of a chicken farm can receive real-time updates on the internal environmental conditions of the farm through the Android application Blynk. The unification of hardware and software enables automated responses to regulate environmental parameters according to pre-determined criteria. When these defaults are exceeded by parameter changes, the system automatically takes action to help preserve the best possible environmental conditions. A centrally con-trolled and monitored data platform, called ESP32, is equipped with sensors that monitor temperature, water level, smoke, gas, and food distribution. The program maintains a comprehensive record of the environmental status of the poultry farm to utilization of the SPI protocol, which facilitates rapid data transmission. The system is set up to give priority to preserving ideal environmental conditions with the least amount of human involvement.

Keywords: Esp32, SPI protocol, Blynk application, Temperature sensor, Gas sensor, Moisture sensor, Humidity sensor, Ultrasonic sensor

1 INTRODUCTION

High concentrations of toxic ammonia gas pose a serious risk to livestock, especially poultry, as it can cause death. In India, the poultry sector employs 30 million farmers and around 850 million birds; therefore, maintaining this essential source of income depends on efficient management. By proposing an embedded poultry farm system with gas sensors for focused monitoring of volatile chemicals, this research suggests a fresh solution to these problems. The goal of the system is to improve farm conditions and reduce the risk of chicken mortality by automating reactions depending on current environmental indicators. Sensors that are attached to an ESP32 are responsible for keeping an eye on things like temperature, water level, gas, smoke, and food dispensing. This makes it possible to monitor and regulate all data centrally. The SPI protocol makes sure that a thorough and current record of the poultry farm's environmental state is maintained for the application. This protocol also makes data transmission more efficient. The conditions in which chickens are grown determine the quality and advantages of chicken meat, which is an essential source of protein. Bird growth and immunity are directly impact-ed by elements like the farm environment, food quality, water availability, and health management techniques. The development of birds is influenced by microbial risks found in farm environments. Therefore, accurate monitoring of environmental parameters is necessary to maximize productivity and guarantee the production of meat of superior quality. Farmers have control over many facets of husbandry and health care in the integrated chicken industry. This involves the deliberate use of antibiotics to reduce the danger of foodborne infections and prevent illness. Notwithstanding the industry's best efforts, maintaining ideal environmental conditions particularly with regard to water sanitation remains a difficulty. By overcoming these

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obstacles, we can maximize the welfare and performance of the birds and guarantee a consistent supply of high-quality, healthy chicken meat.

2 LITERATURE SURVEY

The production of poultry helps farmers stabilize their income outside of harvest seasons, which is a crucial support to agriculture. Our recommended poultry management system's primary objectives are to monitor the environmental factors, such as temperature and moisture, as well as the levels of food and water in the chicken farm. [8]. Productivity is greatly impacted by these variables. The system places a strong emphasis on upholding environmental standards, feed quantities, and the provision of affordable, hygienic equipment. The sensors that measure temperature, moisture content, and water level are the inputs. These include the LM35, FC28, HC-SR04, and HX711 Load Cell Amplifier Module [14]. The NodeMCU board is used to help with the processing. The system provides farmers with timely alerts and intelligent support. In contrast to conventional chicken farming, our approach reduces the need for human involvement while improving output, profitability, and monitoring. It's an efficient, reasonably priced fix. We have also assessed the performance variations and sensor efficiency, recording them for further examination [1].

The real time context monitoring with the help of smart phone notification is enabled in the poultry form with the support of internet of things [7]. This is assisted with notifications in smart phones there by anticipating the circumstances prevailing in the poultry farm. As a result of this mortality rate in chicken, financial crisis, productivity and quality management are channelized and controlled [11]. Monitoring the weather is one of the most important parts of managing a chicken farm. This includes keeping an eye on variables like temperature and humidity, which can affect the quality of food and raw materials, the health of the birds, timely feeding, and food management. The information gathered from the previous steps are stored in cloud based server [5]. They are kept in the form of database and compared with the threshold values [2].The performance of machines and supply chain activities have led to a significant shift in the progression phase of smart farming. The internet of things and sensors influenced the industry in notable scale which led to the revolutionary change in data acquiring across wide farming areas [9].

Our study addresses this technological evolution by introducing an all-inclusive smart farming automation system that is suitable for various agricultural fields. We particularly focus on its use in chicken farming to demonstrate its practical use, highlighting the importance of temperature and humidity sensors for the health of the birds. The features include WiFi based real time monitoring, food distribution, water management, effective rain water utilization and storage. This is associated with webservers and API for recommending best farming practices to the farmers from the procured data [3].For the poultry business to remain relevant, it must continuously turn a profit. If the farmer uses the ineffective technological tools to monitor the poultry, this would result in issues like improper monitoring of parameters like temperature, humidity and ammonia, there by ruining the poultry business [10]. The people use conventional chicken farms to rear their chick-ens.

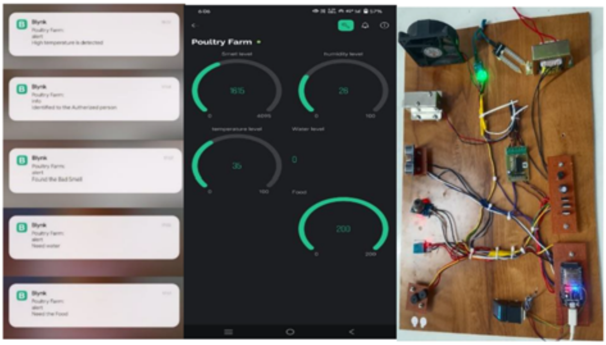
Consequently, this study has made use of contemporary technology to reinvent poultry farms in an era where people from all background or culture or belief can use smart devices. This study proposes and builds the conceptual foundation for an Internet of Things-based chicken farm monitoring system. Poultry farmers can use this technique to remotely monitor their farm via their website [4].In India, one of the most significant and healthiest sources of revenue is the poultry farm. However, managing a chicken farm does involve a lot of work because it calls for dihydrogen monoxide, food, general bird management, health monitoring, and hygiene [15].

The real work is more demanding and complex. Thus, in order to ascertain the proprietors of the chicken farm. It is recommended to use an intelligent automated poultry management system based on the Internet of Things [12]. The program makes use of sensors housed inside containers to water and feed birds. When the dihydrogen monoxide and stock element are low, the system will sound an alarm. This technique allows for the buildup of eggs, the pure supply of dihydrogen monoxide, and the automatic distribution of food [6].

3 DESIGN AND IMPLEMENTATION

Built on top of the ESP8266, NodeMCU is an open-source platform that functions as a flexible tool to facilitate Wi-Fi-based data transfer and item interconnectivity. This platform combines firmware from the ESP8266 Wi-Fi Systems with hardware built around the ESP-12 module. Its adaptable design makes it ideal for numerous IoT applications. The suggested solution creates a wireless network and makes use of the Blynk app to send da-ta to a web server across the internet without any problems as notification as shown in Figure 2. The system consists of a power source outfitted with necessary parts such a voltage regulator, capacitor, bridge rectifier, and transformer to guarantee steady functioning. This stable configuration creates the foundation for dependable and continuous data sharing. NodeMCU serves as the system's backbone in this architecture, enabling communication between its many parts. Real-time data from sensors and actuators may be effectively transferred to the cloud via its connection with the Blynk app, allowing for remote monitoring and control. Users can now obtain essential information and take required action from any location with internet access thanks to this connectivity. Along with improving accessibility and scalability, the Blynk app's integration of NodeMCU facilitates faster data transfer. The system can readily accommodate new functionalities and adapt to changing needs by utilizing the current internet infrastructure. This adaptability guarantees that the suggested remedy stays applicable and efficient in a range of situations.

The flow diagram that demonstrates how the experimental setup functions is displayed in Figure 1. An information system was developed that could monitor the ammonia gas concentration in real time and alert users via a mobile device if the threshold value was exceeded. It did this by using a MQ135 gas sensor. If the amounts of dangerous gases increase, the motor driver is responsible for activating the exhaust fan. The lock will open if the fingerprint matches the database that was initially saved. The information obtained from the sensors is sent to the user through a buzzer, which helps them become aware of their surroundings. We can access the system's status from anywhere at any time because we're using IOT technology to access the cloud storage system through a mobile phone. The current system detects environmental conditions by using the Internet of Things. The controlling and managing processes are automated based on the data collected form the sensor. The homepage updates every five seconds with the sensor values, which are shown in real time.



Blynk
Poultry Farm:
alert
High temperature is detected

Blynk
Poultry Farm:
info
Identified to the Autherized person

Blynk
Poultry Farm:
alert
Found the Bad Smell

Blynk
Poultry Farm:
alert
Need water

Blynk
Poultry Farm:
alert
Need the Food

Figure 1. Flow diagram of automated solutions for enhanced efficiency in poultry production.

4 RESULT AND DISCUSSION

The system has successfully created a wireless network for data transfer over Wi-Fi, enabling seamless item communication. It does this by employing the ESP8266 platform and Node MCU. Real-time data transfer to a web server through the internet connection has been accomplished by integrating the Blynk app. The prototype, shown in Figure 2, shows how the system works, especially when it comes to using the MQ135 gas sensor to measure ammonia gas concentration in real time. If the threshold value is surpassed, the system effectively notifies users via mobile devices, guaran-teeing prompt intervention. In addition, the incorporation of a motor driver to initiate the exhaust fan in reaction to elevated gas concentrations amplifies safety protocols in the context of chicken farms. To improve overall environmental management, the system also includes sensors to monitor food presence using an ultrasonic sensor and water level using a moisture sensor. A finger-print lock ensures regulated access to designated locations within the farm premises, adding an additional layer of protection. Through the use of cloud storage and mobile devices, IoT technology provides remote access to the state of the system. Farm managers will find it more convenient to be able to keep an eye on and control environmental conditions at any time and from any location.

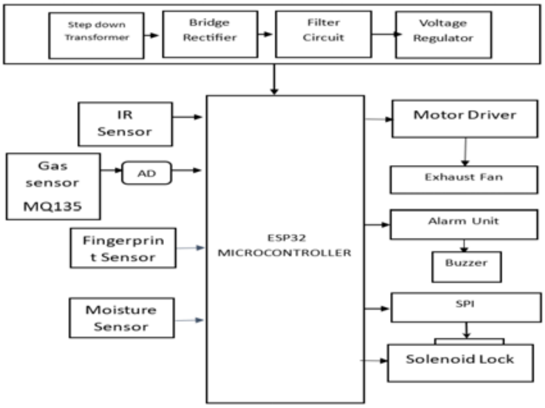


Figure 2. Notification alert, real time update and prototype.

The ultrasonic sensor is positioned within the food container, while the moisture sensor is situated within the water container, both embedded into the ground of the poultry farm. Additionally, the gas sensor is affixed to the side wall of the farm to detect air pollution and smoke. For security purposes, the solenoid lock and fingerprint sensor are installed at the entrance gate as shown in the Figure 2. Real-time sensor updates are displayed on a mobile application with a user-friendly interface designed for easy comprehension by all users. Sensor values, excluding moisture, are presented in speedometer format, while moisture levels are depicted in binary format as shown in the Figure 2.

5 CONCLUSION AND FUTURE SCOPE

Our poultry farm solution offers affordability and simplicity, utilizing readily available sensors while maintaining a high accuracy rate of 98%. This contrasts with previously employed methods and algorithms, known for their complexity. Poultry farm management has advanced significantly with the implementation of the ESP8266, SPI protocol, and

Blynk environmental control system. Its ability to simplify operations and provide ideal environmental conditions with the least amount of human intervention has been proven by its successful deployment.

In the future, there is a lot of room for the system to be improved and advanced. Artificial intelligence may be used in later iterations to enable more advanced data processing and fore-casting capabilities. The system's evolution must take into account looking at ways to in-crease energy efficiency, scalability for varying farm sizes, and remote management capabilities. To sum up, the system in place now provides a strong basis for the technology that will run chicken farms in the future. Technology has the capacity to advance continuously, making it possible for the system to adjust to new difficulties and support effective and sustainable methods of raising chickens essential. Identifying and responding to security breaches is delayed in the absence of real-time monitoring capabilities.

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Automated tomato disease detection and classification using image processing and machine learning for precision agriculture

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ABSTRACT: Research aims to diagnose tomato leaf disease using Color Moments, capturing Mean, Standard Deviation, and Skewness. Photos of leaves with Septoria Leaf Spot, Early Blight, and Late Blight undergo feature extraction and segmentation. Color Moments from various channels distinguish infected from healthy leaves, advancing automated disease recognition. The approach, leveraging machine learning and image processing, enables accurate, early diagnosis crucial for disease control. It underscores Color Moments' adaptability for photo indexing and sets a framework for categorizing plant ailments. This technology's development highlights the importance of image-based methodologies in plant pathology, promising enhanced automation and accuracy in disease diagnosis.

Keywords: Plant disease detection, image processing, Color Moments, disease classification, tomato leaf diseases, automation

1 INTRODUCTION

Precision farming is new agricultural evolution addressing variability in all areas of agricultural output by using concepts and technology. Its primary goals are to improve environmental quality and agricultural performance and reduce the overall farm expenses. [12] The foundation of precision farming is the collection and analysis of data to enable informed decision-making at every stage of the farming process. This includes data on crop health, weather, soil condition, and resource management. This data may be used by farmers to enhance their practices and boost productivity. It is widely estimated that there are between 5 and 6 billion Smart phones on the earth by 2020. [13] One of the key objectives of precision farming is the efficient use of resources such as water, fertilizers, and pesticides. By using technology like sensors and data analytics, farmers can apply these resources precisely where and when they are needed, reducing waste and environmental impact.

Numerous technologies, such as GPS, remote sensing, drones, Internet of Things devices, and machine learning, are used in precision farming. These technologies provide farmers the instruments they need to better monitor and manage their farms, and they are always changing to meet the demands of the industry. [1] Plant illnesses can be caused by a variety of circumstances, which can destroy crops and wreak havoc on leaves. These circumstances may have a significant negative impact on a country's economy, especially given that agriculture employs 90% of the world's population. It is remarkable that agriculture produces over 80% of the world's food. Nonetheless, it is distressing to realize that pests and plant diseases destroy more than half of this food. This massive loss has a tremendous impact not just on the world's food supply, but also on food security and the global economy. [6]

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One of the most popularly grown and consumed vegetable in China and India is the tomato. [12] It's necessary to look into and research the problems that lead to tomato illness. Diseases that impact tomato crops greatly lead to significant losses in the agricultural industry. The tomato crop is grown all year round, although mostly in the winter and summer. Environments increase the susceptibility of plants to bacterial, viral, and fungal diseases. [2] With a sizable production, the tomato is regarded as the second-most important vegetable crop globally. It also acts as a model plant for genetic studies on a variety of traits, including as fruit quality and stress tolerance [3]. Image processing techniques evaluate and manipulate images using a variety of computer and mathematical methodologies. These approaches are used in a variety of applications, including feature extraction, pattern recognition, and image categorization. [10]

A method for assisting tomato growers in spotting disease by taking pictures of plant leaves. Through the analysis of plant pictures, it may be used to identify illnesses in various plant sections, including leaves, stems, roots, and fruits. Plant diseases may display complex visual patterns. This complexity necessitates the development of sophisticated visual pattern interpretation algorithms. [4]

Several research involving plants can benefit from image processing, including:

- Disease Detection: Analyzing photos of plant leaves helps identify and classify diseases based on visual cues like discoloration or spots.
- Crop Monitoring: Remote sensing techniques, like drone or satellite photography, capture agricultural areas to assess crop health, growth, and aid in decision-making for farmers.
- Calculating the area that insects have destroyed.
- Nutrient Deficiency Detection: Photos of plant leaves are analyzed to detect symptoms of nutrient deficiencies, guiding farmers in adjusting fertilizer application.
- Environmental Studies: Image processing aids in monitoring vegetation changes, deforestation, climate change impacts on plant species, and ecosystem analysis using satellite and drone images.

Tomato plants in Iowa are prone to a common fungal disease known as early blight, which causes early leaf-loss and the formation of distinctive brown to black spots. To reduce the disease's impact on crop output and quality, appropriate management techniques include the adoption of resistant tomato varieties, chemical control, and cultural treatments.Late blight, a rare but deadly fungal disease that produces rotting fruit, uneven greenish-black blotches on the leaves, and water-soaked areas on the leaves, is a threat to tomato plants in Iowa. Specific management measures and attention to detail are essential to prevent the development of late blight in cold, wet weather, with an emphasis on avoiding crop rotation with potatoes. [8]

Viral plant infections may be especially difficult to detect since they do not usually have obvious visual signs. Symptoms of viral infections might be difficult to distinguish from those of other disorders, such as nutritional deficits or pesticide damage, causing misunderstanding. Insects such as aphids, leafhoppers, cucumber beetles, and whiteflies are common vectors of illnesses such as the mosaic virus. Infected plants may display signs such as curled or wrinkled leaves, limiting the plant's development [11]. Although individuals may visually detect plant illnesses, their judgments are limited by reasons such as exhaustion, unpredictability, the need for consistency, continual education, the risk for harm, and sensitivity to perceptual illusions. This underscores the importance of looking at additional tactics, such as automated image processing, to increase the precision and efficacy of plant disease identification. [14]

Farmers typically utilize visual examination to discover plant diseases with their unassisted eyes. Farmers must be able to detect plant disease symptoms in order to use this method. It does, however, need some experience and is largely dependent on a person's knowledge of plant health. Consulting with agricultural professionals or specialists is another option. However, due to the high cost of consulting specialists, this alternative is only available to a limited percentage of farmers typically fewer than 1%.Another method is more accessible and economical solution. These methods employ technology to acquire and study plant images, allowing for automated disease identification and diagnosis. Image processing makes plant disease diagnostics more economical and maybe more accurate, allowing more farmers to benefit. [2]

The goal of the study challenge is to develop an automated system that uses image analysis to accurately identify and classify diseases in tomato plants. Maintaining agricultural productivity and quality requires early disease detection. Conventional techniques that depend on human specialists' visual inspection take a lot of time and are prone to mistakes. The goal of the research is to improve precision agriculture methods by developing a more accurate and efficient method for recognizing and classifying tomato illnesses by utilizing machine learning and image processing (Figure 1).

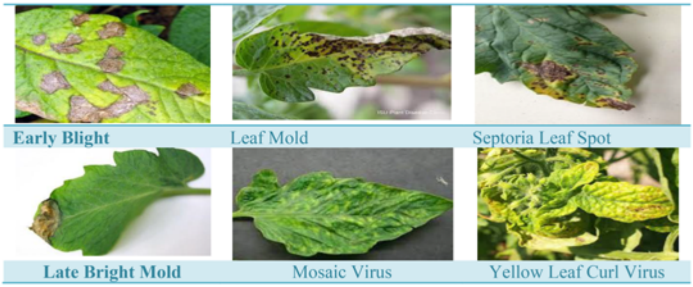

Figure 1. Images of tomato leaves.

2 LITERATURE REVIEW

There are already many work in this filed, some of the works are:

This work uses edge detection, color feature extraction, and histogram matching to develop a great computerized method for identifying tomato plant diseases. By comparing histograms and identifying healthy and unhealthy plant leaves, the method is validated [5]. [15] reaches a high degree of accuracy when diagnosing different plant diseases. This demonstrates how deep learning approaches can improve the accuracy and efficacy of agricultural disease identification. [4] made an important addition by using the Triangle thresholding technique to separate the lesion zone on tomato leaves. Their technique had an average accuracy of 98.60%, illustrating image processing's potential for properly detecting illness severity. This method lowered subjectivity in traditional illness severity estimates while also reducing human error.

The application did a good job of identifying and categorizing leaf diseases with minimal computing input. It also offers the benefit of early disease identification, which could help with early problem diagnosis. The study recommends using hybrid algorithms, fuzzy logic, artificial neural networks, and Bayes classifiers to enhance the classification process and increase recognition rates [7].

3 PROPOSED METHODOLOGY

Images of several tomato leaf diseases taken with smart phones or camera at higher quality are required. Image Preparation and Feature Extraction. The experiment included ten different tomato leaves infected with Septoria Leaf Spot, Early Blight, and Late Blight.

3.1 *Color moments*

3.1.1 *Mean (μ)*

- Mean is a first-order moment that offers the image's average color value.

- It is determined by dividing the total number of pixels in the picture by the sum of the color values for each pixel.
- The formula is : $\mu = \Sigma\Sigma Pnm/Np$ (1)

3.1.2 *Standard deviation (σ)*

- The second-order moment is the standard deviation, which quantifies the volatility or dispersion of the color distribution.
- It shows the amount that color values vary from the mean.
- It is calculated as the color distribution's variance squared.
- Formula : $\sigma = \sqrt{}[\Sigma\Sigma(Pnm - \mu)^2/Np]$ (2)

3.1.3 *Skewness (s)*

- The third-order moment, also known as skewness, represents how uneven the color distribution is.
- It determines how skewed the color dispersion is to one side.
- It is computed using the third central moment, or the expected value of $s = \Sigma\Sigma\ (Pnm - \mu)^3\ /\ Np$
- Formula : $s = \Sigma\Sigma(Pnm - \mu)^3/Np$ (3)

  In these formulas:

- Pnm represents the color channel (e.g., Red, Green, or Blue) at the mth pixel.
- Np represents the total number of pixels in the image.

Step 1: Separation of RGB Color Components
Each image was initially separated into its red, green, and blue color components using the following MATLAB commands.

```
red = rgb_image(:, :, 1);
green = rgb_image(:, :, 2);
blue = rgb_image(:, :, 3);
```

Step 2: Calculation of Color Moments (CM):
Three Color Moments (CM) were calculated for each color component (red, green, and blue). Each image received a total of nine characteristics as a consequence of this procedure. The CM values, in addition to giving important statistical information on color distribution, may be used to discriminate between healthy and diseased tomato leaves. Table 1 shows the predicted Color Moment characteristics for each picture. Later steps of the image processing and machine learning pipeline will utilize these traits to categorize and diagnose illnesses in tomato leaves [9].

Table 1. Predicted color moment characteristics.

Image	CM1 (Red)	CM2 (Red)	CM3 (Red)	CM1 (Green)	CM2 (Green)	CM3 (Green)	CM1 (Blue)	CM2 (Blue)	CM3 (Blue)
1	0.4377	0.1844	0.2258	0.4936	0.1769	0.2080	0.4258	0.1906	0.2152
2	0.4673	0.1711	0.2108	0.4841	0.1956	0.2272	0.3106	0.1538	0.1842
3	0.3094	0.2445	0.2806	0.4712	0.2337	0.2655	0.2955	0.2267	0.2586
4	0.2705	0.2608	0.3044	0.4766	0.2479	0.2765	0.1663	0.1651	0.1920
5	0.5248	0.2227	0.2492	0.5706	0.2429	0.2790	0.4147	0.1921	0.2116
6	0.4282	0.2150	0.2428	0.5097	0.2005	0.2268	0.2424	0.1921	0.2292
7	0.3410	0.1782	0.2118	0.4815	0.1930	0.2137	0.1970	0.1638	0.2071
8	0.2648	0.1534	0.1902	0.5802	0.1284	0.1642	0.2468	0.1353	0.1629

Algorithm:
Step 1: Image Collection
Start by using a digital camera or a mobile device with a good camera to take high-resolution pictures of tomato plant leaves. Verify if the photos are clear and well-lit.

Step 2: Image Preprocessing
Use the following filters to enhance the quality of the images:

a) Smoothing: To improve picture clarity and lower noise, apply Gaussian or median filters.
b) If required, change the contrast to bring out the greatest details in the picture.

Step 3: Image Segmentation
Use image segmentation to discern between damaged and healthy leaf sections:

a) Use the inverse difference approach or an appropriate segmentation strategy.
b) Create two segmented photos, one with the infected parts cropped off and the other with only the sick sections present.

Step 4: Feature Extraction
Extraction of relevant information from segmented RGB pictures, with a focus on texture and color:

a) Convert the RGB image to the HIS (Hue, Saturation, Intensity) color space to gain additional color information.

Color co-occurrence matrices should be computed for the hue, saturation, and intensity (HIS) channels.

d) Calculate texture parameters such as picture homogeneity using energy.

Entropy is used to quantify image complexity and predictability.

Correlation is a technique for determining linear connections between gray tone orientations.

iv. Homogeneity, which quantifies the similarity of nearby pixels.

d) Don't forget to store these feature values for each segmented image.

Step 5: Disease Classification

Sort tomato plant leaf diseases into the following groups based on the information gathered:

a) Using labeled datasets of damaged and healthy leaves, train a machine learning model (e.g., SVM, Random Forest, or a deep learning model like CNN).
b) Provide the segmented RGB picture feature vectors to the trained illness classification model.
c) The output of the program will reveal if and what type of disease is present on tomato leaves.

Step 6: Result Interpretation

- Consider the kind and degree of illness while reviewing categorization findings.
- Create reports that convey a plethora of information about the plant's state, whether through numerical data or visual assistance.

Step 7: Post-Processing and Decision-Making

Make educated judgments about sickness treatment and management based on the categorization results:

a) Take appropriate steps, such as using specialist pesticides, isolating wounded plants, or increasing surveillance.

Step 8: Validation and Iteration

- Test the algorithm's performance on a regular basis with new data and actual facts.
- To increase the resilience and accuracy of illness identification, modify the algorithm and model parameters in response to input and new data.

4 CONCLUSION

Precision farming is a crucial technique for improving agricultural operations and managing crop output unpredictability difficulties. Farmers may make better informed decisions at every level of the farming process by leveraging technology and data analysis, which will eventually boost environmental sustainability and agricultural success. In addition, the introduction highlights the significance of plant diseases for the world's food security and economics, specifically focusing on tomato harvests in China and India. Since plant illnesses can result in large crop losses, particularly in the case of viral infections, early diagnosis and management are essential for agricultural security. The topic of this introduction is "Automated Tomato Disease Detection and Classification Using Image Processing and Machine Learning for Precision Agriculture." This research seeks to develop an automated system capable of reliably identifying and categorizing diseases in tomato plants, so replacing labor-intensive visual inspection techniques with a more reliable and efficient alternative. In the context of precision agriculture and the need to cure plant diseases, the proposed study aims to boost agricultural output and quality while ensuring farmers can swiftly control disease outbreaks and lessen their implications. By merging image processing and machine learning techniques, this study aims to increase the efficacy and precision of disease detection in tomato crops, benefiting the agricultural sector and the world's food production.

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Bioleaf AI: Unravelling plant leaf diseases with AI-Powered classification

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ABSTRACT: Pioneering method for detecting diseases in plant leaves by employing the architectural framework of Convolutional Neural Network (CNN) and leveraging Deep Learning techniques in the following paper. The approach detailed in this study showcases innovative strategies for accurately identifying various plant leaf diseases using advanced computational algorithms and neural network models. With agricultural losses due to such diseases in mind, we leverage a dataset of 87,867 images covering 38 classes of healthy and unhealthy leaves for robust model training. Our CNN model achieves an impressive 98.91% disease classification accuracy, aided by image preprocessing, segmentation, and feature extraction. Comparative analysis validates our approach's competitiveness, offering valuable insights for agricultural management through comprehensive disease identification and actionable insights for farmers.

Keywords: Plant disease detection, Comparative analysis, Convolutional Neural Network, Hyperparameter optimization, Deep Learning, Image classification

1 INTRODUCTION

Plants suffer substantial diseases which have impact on crop output and livelihoods of millions of people globally, endangering global food security [1]. Despite agricultural breakthroughs, it is still difficult to recognize certain diseases within the stipulated time, especially in areas with limited access to diagnostic resources. The nexus of image processing and artificial intelligence (AI) has created new opportunities for precision agriculture in recent years, providing encouraging approaches to disease control and detection [2]. This study centers on the utilization of transfer learning techniques combined with deep CNNs to address pressing issue in identifying plant diseases. The remarkable efficacy of deep CNNs has been evident across various domains, such as object recognition and image categorization [3].

Deep CNNs are distinguished by their capacity to extract complicated characteristics from images. Through the utilization of transfer learning, we hope to improve the efficacy and precision of illness identification models while reducing the difficulties brought about by a lack of training data [4]. Transfer learning allows knowledge to be transferred from previously trained models to new tasks. Our study improves on current approaches by using picture augmentation techniques to increase model performance and reduce the chance of overfitting [5]. Additionally, we investigate how dropout regularization and various mini-batch sizes affects productivity of suggested CNN model [6].

We hope to show how well our method works to diagnose plant illnesses and open the door to more effective and sustainable agricultural methods by conducting thorough evaluations and comparative assessments using cutting-edge algorithms [7]. Some surveys of relevant publications in the topic is given in Section 2, along with an explanation of the shortcomings of the current methods.

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Section 3 discusses the materials and techniques utilized for this study, along with the dataset description, model design, and training protocols. The experiment findings are shown in Section 4 along with in-depth analysis and observations.

2 RELATED WORKS

Artificial Intelligence (AI) and Deep Learning have emerged as significant contributors in agriculture, particularly within the realm of plant disease detection. Various methodologies have been suggested by scholars, encompassing clustering algorithms artificial neural networks (ANN) and support vector machines (SVM). An illustration of this is the successful application of a LeNet architecture in addressing banana disease identification [10]. Similarly, in a study, [12] utilized Region-based Fully Convolutional Network (R-FCN), Single Shot Multibox Detector (SSD) and Faster Region-based Convolutional Neural Network (Faster R-CNN) for the detection of tomato diseases. Notably, investigations on the 2017's Wheat Disease Database, as indicated in [14], displayed VGG-FCN-S and VGG-FCN-VD16 models achieving significant accuracies of 97.95% and 95.12%, respectively. Moreover, numerous plant diseases have been recognized through deep learning models trained on extensive datasets like the Plant Village dataset. For instance, [16] employed the Plant Village dataset to train a 9-layer CNN for disease diagnosis. Similarly, [15] utilized deep CNNs for rice disease detection, achieving an impressive 95.48% accuracy rate with a dataset comprising 500 natural photos. This showcases the efficacy of deep learning in addressing agricultural challenges, particularly in the diagnosis of rice diseases. By employing a dataset that contains 87,848 images that showcases healthy and diseased plan leaves that are employed for the execution of various CNN models to be evaluated [11]. Among the models scrutinized, VGG exhibited the highest accuracy at 99.53%. Furthermore, [17] illustrated the application of CNNs in hardware, specifically in the identification of diseased tomato plant leaves using AlexNet and SqueezeNet. Additionally, innovative methodologies have been introduced to identify apple leaf diseases, such as INAR-SSD in [13], GoogLeNet Inception and merging deep CNN with Rainbow concatenation. This model exhibited exceptional results, boasting a mean Average Precision (mAP) of 78.80%. In conclusion, these studies underscore the effectiveness of deep learning strategies in detecting plant diseases. These strategies typically entail a comprehensive process that have four-steps involving image acquisition, feature extraction, preprocessing, and recognition algorithms.

3 PROCEDURES AND SUPPLIES

This section outlines the methods and materials used in our investigation on the use of leaf pictures to detect crop diseases. The procedure includes gathering data, preprocessing, training the model, and setting up the experiment. These are covered in more depth below. Keep your text and graphic files separate until after the text.

3.1 *Preparing the data*

Photos of plant leaves with and without diseases were obtained from the New Plant Disease Dataset and used in our investigation. Included are 87,867 photos in all, covering 38 different kinds of plants and diseases related to them. Image alterations are applied in order to streamline processing and restrict the CNN network's capabilities. The RGB channel is preserved during the resizing of the original, 256 × 256 pixel images to 128 × 128 pixels. The optimization of processing resources is facilitated by this reduction in image size, all without sacrificing information content.

3.2 *Training the CNN network*

A fundamental element of our research involves the utilization of the Convolutional Neural Network (CNN), which establishes the structure for extracting features from images of leaves, facilitating subsequent categorization. Initially, our proposed CNN architecture undergoes rigorous training using the dataset expounded upon in the preceding section. In terms of feature extraction and classification procedures, this architecture comprises several layers, each fulfilling a specific role. The convolutional layers, serving as the foundational components of the network, are responsible for extracting diverse features from the input images. Moreover, the pooling layers contribute to dimensionality reduction and maintenance of computational efficiency and information integrity through down sampling. More precisely, we employ max-pooling to achieve this reduction. To mitigate overfitting, a common challenge during neural network training, we integrate dropout layers into our architecture. These layers enhance network regularization and generalization capabilities by randomly deactivating neurons during training. The network's operations culminate at the dense layer, where the gathered features are employed for image categorization. Leveraging the characteristics obtained from the pooling layers and convolutional, the input is subsequently classified into one of the 38 predefined categories (Figure 1).

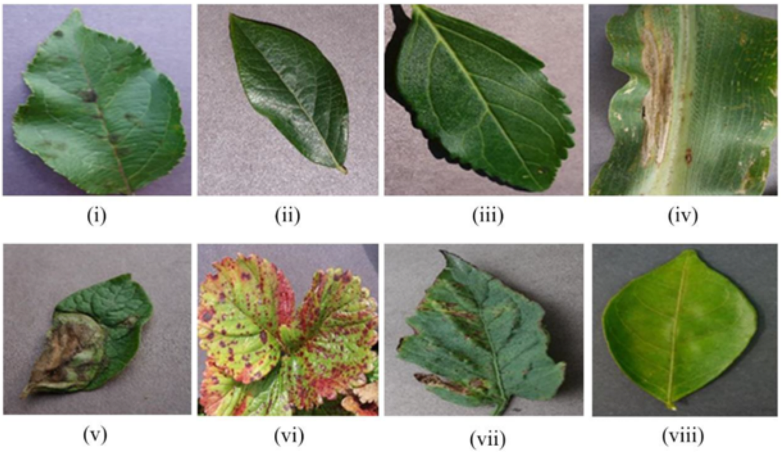

Figure 1. Sample from dataset: (i) Apple (Scab). (ii) Blueberry Healthy. (iii) Cherry Healthy. (iv) Corn Northern having Leaf Bright. (v)Potato Late Blight. (vi) Strawberry Leaf Scorch (vii) Tomato Bacterial Spot. (viii) Orange Hung Long Bing.

Several layers within the architectural design are explicitly designed for the purpose of image categorization tasks. Initially, a rectified linear unit (ReLU) activation function is utilized, followed by a convolutional layer with a kernel size of 3 x 3 and 32 filters. A further convolutional layer follows this one, and it has a 2 × 2 kernel-sized max-pooling layer is placed after 64 identical-sized filters and a ReLU activation mechanism. Next, there is a series of convolutional and max-pooling layers which is comparable to each other, with the third convolutional layer having 128 filters. The resultant feature maps are then gradually reduced in spatial dimension by down sampling those using max-pooling techniques. The next set of layers consists of further convolutional processes, each of which is followed by ReLU activations, which result in feature maps that have a 1024-depth. After that, a global average pooling layer is applied to these maps in order to produce a single feature vector. After that, this vector is flattened into a 1D structure with 1024 parameters. Following additional processing through fully linked layers, the dimensions of this flattened representation drop from 1024 to 512, then to 256, and eventually to an output layer with 38 units, which corresponds to the number of predefined classes for classification which is shown in Figure 2.

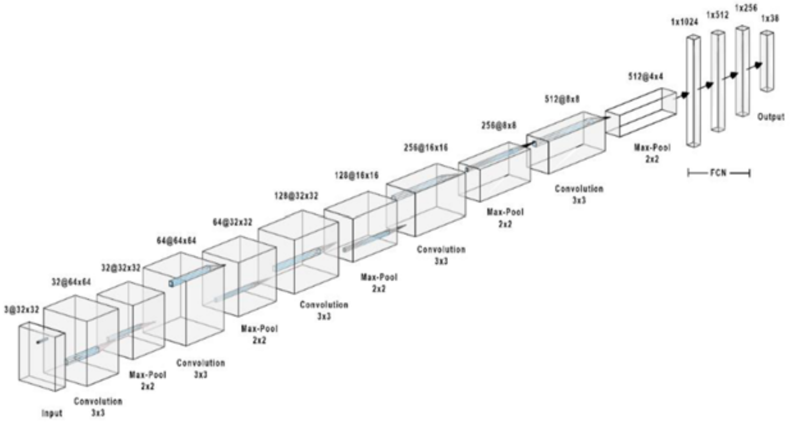

Figure 2. Suggested CNN architecture's layers.

Overall, the goal of architecture is accurately classifying input photos by extracting hierarchical features from them. We carefully adjust hyperparameters like batch size and epoch to maximize the model's outcome. These settings have a big impact on how well the network learns, which in turn affects classification accuracy. Our method, which makes use of a mix of properly thought-out network architecture and tuned hyperparameters which are mentioned in Table 2, guarantees comprehensive training and efficient use of the CNN model for new plant disease classification.

Table 1. Architectural hyperparameters.

Parameter's Name	Count
Training Epochs	20
Batch size	64
Training set size	70295
Learning Rate	0.001
Validation set size	17572

4 FINDINGS

4.1 *Details of the dataset*

The RGB images sourced from the New Plant Disease Dataset [6] are utilized for the training of the proposed CNN Architecture. This dataset comprises a comprehensive assortment of leaf pictures encompassing 38 distinct categories representing both healthy and afflicted plant leaves. The dataset consists of 87,867 photographs, all standardized to a size of 256 × 256 pixels per image. The dataset guarantees diversity in the training samples, encompassing 14 different plant species.

4.2 *Data scrubbing*

Headings, the scrubbing of data is a crucial stage in our methodology that has a substantial impact on the training time and correctness of the suggested design. The RGB images from

New Plant Disease Dataset are customized from their original 256 × 256 pixels to 128 × 128 pixels in order to simplify the training procedure and maximize computing performance. The reduction of the image dimensions effectively reduces the amount of parameters in the structure, consequently decreasing the time required for training while retaining important data necessary for the classification goal.

4.3 *Simulation findings*

In this work, we used a dataset of 87,867 photos of plant leaf diseases to train the suggested CNN architecture. The architecture was then evaluated with 350 previously unknown photographs after validation was completed on a different batch of 17,552 images. 38 different classes of leaf diseases are covered by these photos. The study's Deep CNN model outperformed other models with a prediction accuracy of 98.91%, which offers a detailed comparison of prediction accuracy with other models' results ranged from 50% to 87%. The correctness of validation with respect to error in validation suggested model are depicted Table 2.

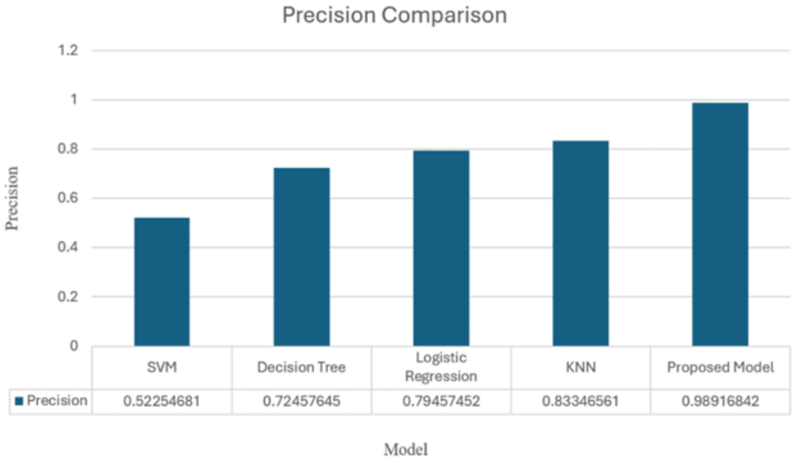

Figure 3. The varied model's precision values.

Table 2. Result.

CNN Design	Correctness of Validation	Error in Validation
architecture	98.91%	0.0393

The validation loss was relatively significant in the first epoch, at 0.2481, but by the last epoch, it had gradually dropped to 0.0325. When it came to identifying illnesses from leaf photos, our suggested design produced a correctness of validation as 98.91% and error in validation as 0.0393 (Figure 3).

5 CONCLUSION

A significant portion of current research is focused on applying various Machine Learning approaches to address common problems. Identifying crop illnesses promptly and accurately is a critical concern for Indian farmers and the agriculture industry. This study explores one such widespread issue. With the help of our suggested CNN architecture, 38 different kinds of good and unhealthy plant leaves can be successfully classified. This CNN architecture obtained an outstanding 99.91% validation accuracy after careful parameter optimization. This highlights the remarkable capabilities of convolutional neural networks, which make them very good at automating the identification of plant illnesses from simple leaf photos. Moreover, it is impossible to overestimate the significance of hyperparameters in determining architecture accuracy. The vital relevance of accurate parameter tuning in model refinement is highlighted by the fact that even little changes to these parameters can result in noticeable changes in accuracy.

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Detection and reporting of wildfires in forests using a wireless sensor network

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ABSTRACT: This research presents a comprehensive system for early wildfire detection and response in forest environments, employing a wireless sensor network and machine learning models. A range of sensors, including temperature, pressure, smoke, humidity, and gas sensors, continuously monitor environmental parameters. Machine learning models, such as the Artificial Neural Network (ANN), Convolutional Neural Network (CNN), Decision Trees (DT), and Random Forest, analyze the data to predict wildfires in advance. The ANN exhibited the highest accuracy at 98.32%, surpassing the other models. Precision, recall, and F1 score further underscore the ANN's effectiveness. This system holds significant promise for proactive wildfire prevention and forest conservation, highlighting the synergy of sensor networks and machine learning in enhancing environmental safety.

Keywords: Machine Learning, Liver Cancer, Diagnosis Prognosis, Medical Imaging

1 INTRODUCTION

Forest fire is one of the major natural disasters causing considerable risk to human life, property and eco-system. "A troubling multi-decadal increase in urban areas experiencing the most extreme dry-wet-dry transitions, coupled with the alarming rise in both wildfire activity and intensity globally since 2020" highlights why better early detection and response mechanisms are necessary. This paper will result in a proper system using wireless sensor networks and machine learning models to ensure timely warnings of any such incidents that can be hazardous for forest areas due to fires. ii Forest fires have a negative impact on the

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environment, socio-economic parameters, and biodiversity. Because of the limitations of coverage and response time, some traditional wildfire detection systems like turrets and hand patrols are less effective or impossible. Proactive prediction with modern technology using wireless sensor networks and machine learning models can also be a solution. We can enhance early detection accuracy and prevent adverse effects on human communities as well as forests ecosystems by determining environmental factors and processing the data over machine learning models to ensure that appropriate measures are taken to control forest fires. Consequently, the employment of wireless sensor networks and machine learning models provides a holistic perspective on wildfire management and prevention solutions that will cover the constantly rising demands for fire detection systems. In this sense, we show a novel semi-applied study for fire prediction using multiple sensors and machine learning to provide benefits relating to increase forest fire prediction accuracy that will increase essential in preventing and responding wildfires. If the setting up of this system goes well, the environmental implications will be major and so too our impact on society. This also has direct repercussions on public health (forest people).

2 METHODOLOGY

The research works focus on the creation of a system using IoT technology for identification and reporting of forest fires at an early stage. There were different sensors in the forest, which kept an eye on some of the major factors like temperature, pressure and humidity etc. gas and smoke as well was part of it. These sensors collected data which was then communicated wirelessly to a central unit where the acquired information could be monitored and analyzed in real-time. The fire detection algorithm was made to process the sensor data continuously and when evidence of a forest fire is found, carry out tasks such as switching on water pump or sounding alarms. Water pump with pumped water the area so that fire dose not affect and production. All this was done in a manner of alarm called to workers/company and approver forces through System Wireless enabled a faster reaction time to fires and allowed the system coverage to be expanded and made more reliable. The implemented system functionality, accuracy and the response time have been verified through extensive testing and calibration procedures. Efficient power management techniques were used to keep these systems alive in forest isolatesaneyou.pac forests. They include the development of a joint solar and generator power budget, which determines the daily and monthly energy production required from each source (solar array, fuel cell or generator). In addition, it took into account low energy consumption of the microcontroller and sensors too so that they can be more reliable and last longer. In conclusion, the system presented in this paper based on IoT was used to accurately detect and report about the occurrence of fire outbreaks at an early stage that prevented them from resulting into massive destruction, ensuring quick action for containing and suppressing wildfires. Architecture of the research is shown in Figure 1.

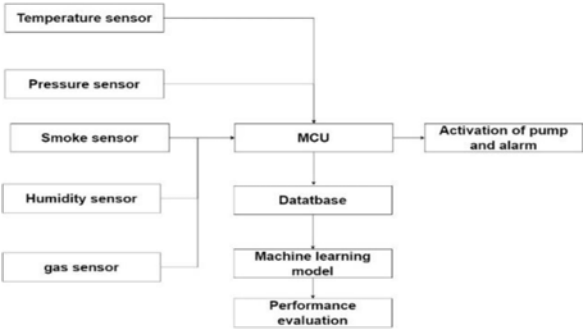

Figure 1. Architecture of the research.

3 SENSORS USED IN THIS RESEARCH

In order to create a wireless sensor network-based system for the early detection and reporting of wildfires in forest environments, the research must carefully arrange and select a variety of sensors. These sensors are essential for keeping an eye on the environmental conditions of the forest and identifying possible fire outbreaks. This section offers a thorough examination of the different kinds of sensors used, their purposes, and the importance of their contributions to the field.

3.1 *Temperature sensor*

Temperature sensors, crucial for detecting wildfires, are strategically placed to monitor variations. Thermocouples, chosen for their robustness and fast detection, transmit data wirelessly to a central unit. Sudden temperature spikes trigger alarms and activate water pumps, ensuring an early response to potential fire outbreaks.

3.2 *Pressure sensor*

Pressure sensors also are used to detect anomalies in atmospheric pressure, which might present a risk of wildfires. Piezoresistive pressure sensors were chosen for their precision and wide range suitability, because they are in a good position to monitor these changes. The MCU then uses and processes that real-time sensor data to help the system better be able to predict and react quickly if it senses potential wildfire conditions.

3.3 *Smoke sensor*

Smoke sensors are an important device that can detect if there is a lot of smoke particles distributing in one place, which usually signifies for fires. The highly sensitive, fast-responding photoelectric and ionization smoke sensor modules send data to the MCU. Upon detecting smoke, the system will sound alarms and initiate response mechanisms such as water pumps and sprinklers to limit the spread of fire.

3.4 *Humidity sensor*

For instance, humidity sensors are an essential component of monitoring the level of moisture in a forest. Low levels of humidity can lead to higher risks of wildfire. As capacitive humidity sensors, being the most reliable and accurate of all, are that’s why they often used for sensing because they read very exact data values. The MCU then takes all that data from the humidity sensors and also uses water pumps, alarms, etc., to react in a way that limits risks associated with wildfires.

3.5 *Gas detectors*

Wildfires produce different types of gases such as carbon monoxide (CO), and it is crucial to gas sensors. “Selective gases sensors like Electrochemical CO sensor should be preferred, because they have higher accuracy.” The MCU deployed in the house receives data from gas sensors and it sets some responses on detecting an increased amount of gases which could lead to fire like starting water pumps or letting authorities know about it.

4 NEED FOR MACHINE LEARNING

A crucial aspect of this research is the incorporation of machine learning methods into the system for early wildfire detection and response. While gathering data in real-time for prompt action in extreme fire scenarios is the main objective of a wireless sensor network, machine learning techniques have also been applied to predict fires, enabling proactive responses when hazardous environmental conditions arise. To improve predictive capabilities, the study combines Convolutional Neural Networks (CNN), Random Forests (RF), Decision Trees (DT), and Artificial Neural Networks (ANN).

4.1 *CNNs, or convolutional neural networks*

Convolutional Neural Networks (CNNs) are good at image recognition and feature extraction which makes CNN helpful in forecasting the wildfires. Based off the analysis of historical data, which will allow scientists to identify patterns and any hotspots for where wildfires could be occurring. For example changes in smoke or variances of temperature. CNNs also give early warning and decision-making time by identifying or signaling patterns that alert or trigger actions.

4.2 *Neural artificial networks (ANN)*

The capability of Convolutional Neural Networks (CNNs) in feature extraction and image recognition is very essential for wildfire prediction. Trained on historical data such as images of forests and patterns of weather, CNNs can catch the first signs indicating there is a wildfire like smoke or temperature distributions that does not make sense. Detailing the system to react for patterns identified by CNN, it offers sufficient time to organize as well as make use of your measures.

4.3 *RF, or random forest*

Random Forest (RF), like other ensemble learning approaches, uses multiple decision trees to improve accuracy and reduce overfitting. RF can do that easily since it has capability to do feature selection and relative importance among all factors affecting wildfire occurrences RF models trained live data needs to be analyzed by the RF model in real-time for predicting and triggering some of the response mechanisms if there are high probability of fire happening.

5 RESULT AND DISCUSSION

Large datasets for early wildfire detection can be developed with the help of controlled fire experiments. An increase in temperature can be planned to start controlled fires and thus, more systematic data is gained. Each environmental condition such as, temperature, pressure and gas concentration or smoke density has been recorded. Simultaneous temperature and pressure monitoring will provide information regarding the change in weather patterns. There is a direct relationship between smoke density and fire intensity, this is useful for detecting the fires Get some numbers of gas concentrations (especially carbon monoxide): it will give you a pretty good idea on how well that combustion is going. This rich dataset helps machine learning models to better predict early signs of wildfire and reduce risks. Table 1 shows the sensor readings and actuator response.

Table 1. Sensor readings and actuator response.

Reading	Temperature (°C)	Pressure (kPa)	Smoke Density	Gas Concentration (ppm)	Actuator Response
1	28.5	101.2	12.3	15	No Activation
2	29.2	101.1	11.9	14	No Activation
3	31.8	100.9	16.7	17	No Activation
4	33.7	100.8	18.5	21	No Activation

(*continued*)

Table 1. Continued

Reading	Temperature (°C)	Pressure (kPa)	Smoke Density	Gas Concentration (ppm)	Actuator Response
5	36.2	100.7	22.1	27	No Activation
6	38.9	100.6	25.3	32	No Activation
7	42.4	100.4	29.8	39	No Activation
8	46.1	100.3	35.2	48	No Activation
9	50.3	100.2	40.9	58	No Activation
10	54.7	100.0	47.1	69	Water Pump On
11	57.5	99.9	52.4	78	Water Pump On
12	59.8	99.8	56.3	86	Water Pump On
13	61.2	99.7	60.1	94	Water Pump On
14	62.9	99.6	63.8	101	Water Pump On
15	64.3	99.5	67.6	108	Water Pump On

Based on this dataset, after splitting using 70 % of it to build the model and the remaining 30% for testing across all models were used. The ANN achieved an accuray of 98.32% in early sign detection, as we can easily extract complex temporal patterns with them. CNN achieved 96.5% accuracy on identifying such visual cues. The DT classifier, having 92.1% accuracy and being human-interpretable was kept in the ensemble model. An accuracy of 88.7% was achieved by the ensemble learning method Random Forest This paper illustrates these outcomes visually illustrated in Figure 2a, which facilitates the early wildfire detection model selection and integration. The results seem to indicate that machine learning may improve wildfire prediction and response systems, which ANN outperformed in predictive accuracy.

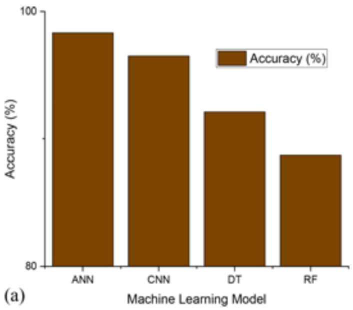

Figure 2a. Accuracy of the machine learning model

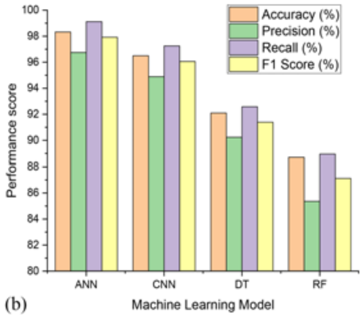

Figure 2b. Performance score of the machine learning model.

In the context of early wildfire detection, Figure 2b shows the performance evaluation of four machine learning models: Random Forest, Convolutional Neural Network (CNN), Decision Trees (DT), and Artificial Neural Network (ANN). These models are assessed using crucial metrics that are shown as percentages: accuracy, precision, recall, and F1 score. A prediction's accuracy, which measures its overall correctness, shows that the ANN performed at 98.32%.

6 CONCLUSION

In conclusion, our research has successfully developed a dependable system for the early detection and reporting of wildfires in forest environments using a wireless sensor network and machine learning models. The results demonstrate the effectiveness of this method in predicting wildfires, with the Artificial Neural Network (ANN) leading at 98.32% accuracy rates. These findings offer a workable solution to lessen wildfires' destructive effects, save forests, and enhance environmental safety. This study's integration of advanced machine learning techniques with sensor data significantly advances proactive wildfire prevention and response by offering a helpful tool for maintaining forest ecosystems and assisting with disaster management efforts.

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Empowering agriculture with AI: The smart agrohub initiative

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ABSTRACT: The proposed model of "Smart Agrohub: Integrating AI for Precision Farming and Agricultural Sustainability "is a far reaching project utilizing Man-made brainpower (computer based intelligence) and AI (ML) for ground breaking headways in farming. The framework incorporates modules that synergistically improve cultivating rehearses. For Harvest Suggestion, high level ML calculations like Choice Trees and Backing Vector Machines are utilized to examine occasional weather conditions, upgrading crop decisions. Compost Proposal uses calculations, for example, K-Means Clustering algorithm to tailor ideas in light of soil synthesis. Crop Illness Discovery incorporates Convolutional Neural Network (CNNs) to recognize infections from pictures, while Vermin Suggestion sends calculations like Apriori for affiliation rule mining. Crop Value Assessment integrates Linear Regression models to foresee market costs. A Rancher's Helping Chatbot controlled by Neural Language Processing (NLP) guarantees continuous, easy to understand collaboration, giving a comprehensive, information driven way to deal with accuracy cultivating and economical farming.

Keywords: Sustainable Agriculture, Precision Farming, Artificial Intelligence, Machine Learning, Linear Regression, Natural Language processing, K-Means Clustering

1 INTRODUCTION

Our Project marks a significant stride towards the convergence of technology and agriculture. The initiative, which is based on the revolutionary capabilities of artificial intelligence (AI) and machine learning (ML), has the ability to completely change traditional farming methods by giving farmers access to cutting-edge tools for making decisions and encouraging sustainable agricultural management. At the heart of this initiative is the Crop Recommendation module, a cornerstone leveraging sophisticated ML algorithms such as Decision Trees and Support Vector Machines. These algorithms go beyond mere data analysis; they interpret both historical and real-time seasonal weather data, providing farmers with nuanced recommendations for optimal crop selection based on prevailing environmental conditions. The dynamic adaptability of machine learning ensures precision even in the face of changing weather patterns, offering farmers a reliable guide for informed crop choices. Crop Disease Detection takes a proactive stance by utilizing Convolutional Neural Networks (CNNs) for image analysis. The system is able to identify and diagnose crop conditions with a high degree of accuracy because it was trained on a wide collection of crop disease images.

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2 LITERATURE REVIEW

By comparing old related projects, we can discern the evolution of methodologies and advancements in addressing the challenges of modern agriculture. In the domain of Crop Recommendation, earlier projects often relied on rule-based systems, lacking the adaptability of machine learning models. Contemporary approaches, as adopted by "Smart Agrohub," leverage advanced ML algorithms such as Decision Trees and Support Vector Machines. These models analyze both historical and real-time seasonal weather data, providing dynamic and precise recommendations for optimal crop selection based on environmental conditions.

Fertilizer Recommendation in older projects typically utilized basic soil testing without the sophistication of clustering algorithms. "Smart Agrohub" employs K-Means clustering, enabling a detailed analysis of soil composition. This advanced approach tailors fertilizer recommendations by optimizing nutrient supply based on the unique characteristics of the soil, contributing to enhanced crop yield and reduced environmental impact. Crop Disease Detection in earlier works often relied on manual observation or basic image processing techniques. The incorporation of Convolutional Neural Networks (CNNs) in "Smart Agrohub" signifies a paradigm shift. CNNs, as opposed to traditional methods, excel in recognizing complex patterns in images. The "Smart Agro hub" project distinguishes itself by incorporating advanced ML algorithms in each module, surpassing the capabilities of earlier projects. The comparison highlights the evolution from rule-based and traditional methods to more adaptive and efficient machine learning techniques, positioning "SMART AGROHUB" as a pioneering solution for precision farming and agricultural.

3 METHODOLOGY

In Proposed model, we have utilize the approaches of machine learning models and algorithm to evaluate valuable aspects on farmers to help to get sustainable agricultural practice.

3.1 *Decision tree algorithm*

The decision tree algorithm serves as a powerful tool in machine learning for crop recommendation purposes. By recursively splitting the input data according to feature properties, it achieves its main goal of producing a tree-like structure of decisions and results. When it comes to crop recommendations, a decision tree can examine many aspects of soil, climate, and other farming variables to select the best crop in a certain situation. The computation formula is shown below.

$$\mathrm{H(S)} = -\mathrm{p1}\log 2(\mathrm{p1}) - \mathrm{p2}\log 2(\mathrm{p2}) - \ldots - \mathrm{pnlog2(pn)} \tag{1}$$

3.2 *Naive Bayes algorithm*

The technique is frequently employed in machine learning to recommend crops. Its primary purpose is to classify or recommend a crop based on the probability of observing certain features given a particular class. Naive Bayes is particularly useful when dealing with multiple features and their interactions, making it suitable for agricultural scenarios where various factors influence crop selection. The Naive Bayes algorithm calculates the probability of a particular crop given the observed features (such as soil type, climate, etc.). It optimizes the computations by assuming that the features are conditionally independent. In the context of crop recommendation, Naive Bayes helps determine the likelihood of a crop being the best fit for a given set of conditions (Figure 1). The formula for calculation is given below.

$$\mathrm{P(Ck - x1, x2, \ldots, xn) = P(x1) \cdot P(x2) \cdot \ldots \cdot P(xn)P(Ck) \cdot P(x1 \mid Ck) \cdot P(x2 \mid Ck)} \\ \cdot \ldots \cdot \mathrm{P(xn \mid Ck)} \tag{2}$$

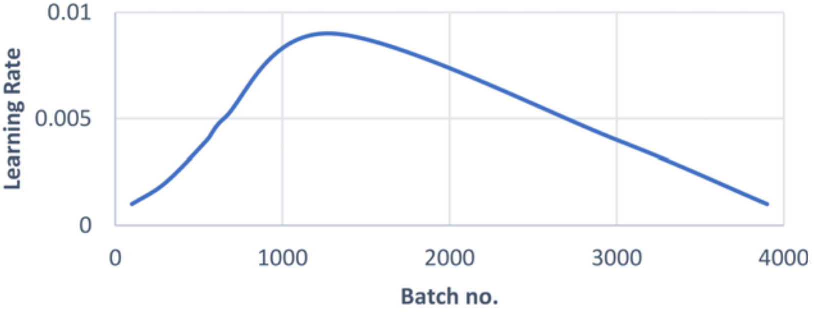

Figure 1. Learning rate vs batch no.

3.3 *XBOOST*

XG Boost (Extreme Gradient Boosting) is a powerful algorithm used for crop recommendation purposes in machine learning. The objective is to build a group of weak predictive models, usually decision trees, and then gradually enhance their capacity to produce accurate projections. When it comes to crop selection, XG Boost can manage complicated relationships between different agricultural variables and provide accurate suggestions. XG Boost excels in optimizing predictive models for both classification and regression tasks. For crop recommendation, it aims to build an ensemble model that combines the strengths of multiple decision trees, correcting errors and enhancing overall accuracy. XG Boost is particularly effective in handling large datasets and capturing intricate patterns in the data, making it suitable for complex agricultural scenarios with numerous influencing factors (Figure 2). The formula for calculation is given below.

$$\mathrm{Objective\ \ Function} = \Sigma \mathrm{i} = 1\mathrm{nL}(\mathrm{yi}, \hat{\mathrm{yi}}) + \Sigma \mathrm{k} = 1\mathrm{K}\ \ \Omega(\mathrm{fk}) \tag{3}$$

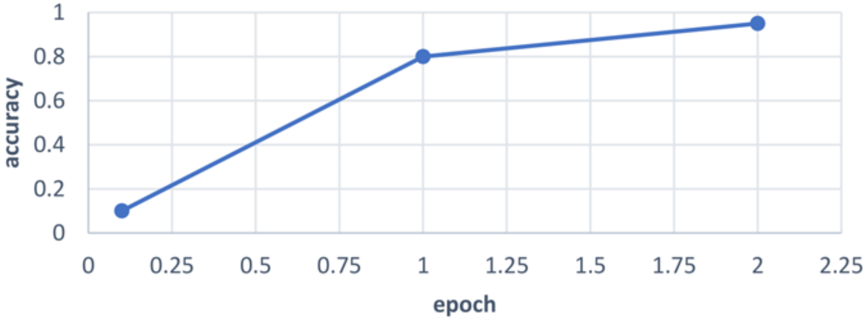

Figure 2. Accuracy vs No of Epochs.

3.4 *K-Means clustering*

In machine learning, the K-Means Clustering technique is frequently utilized to propose fertilizers. Its primary purpose is to group similar data points into clusters, helping identify patterns and trends in the data. In the context of fertilizer recommendation, K-Means can be applied to analyze soil composition data and categorize regions with similar soil characteristics, aiding in the tailored recommendation of fertilizers. K-Means aims to use similarity in order to divide a dataset into separate categories (clusters). In the context of fertilizer recommendation, K-Means helps identify homogeneous groups of soil samples, allowing for the customized recommendation of fertilizers suited to specific soil types (Figure 3). The formula for calculation is given below.

$$J(c,\mu) = \Sigma i = 1K\Sigma j = 1ni \; || \; xij - \mu i \; || \; 2 \qquad (4)$$

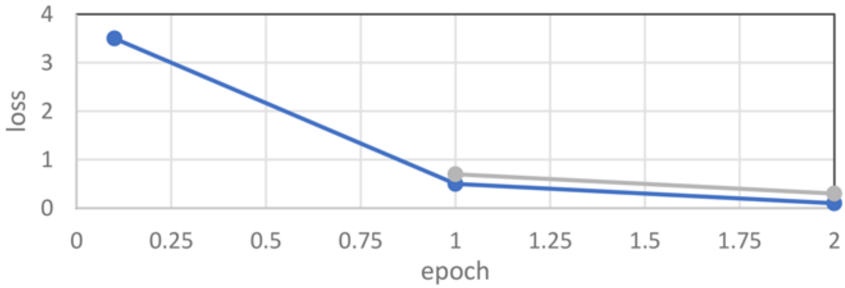

Figure 3. Loss vs No of Epochs.

3.5 *Convolutional neural network (CNN)*

In precision farming, the Convolutional Neural Network (CNN) is a deep learning technique that is frequently used for crop disease detection and pesticide recommendation. CNNs are particularly effective in image analysis tasks, making them suitable for identifying diseases in crop images and subsequently recommending appropriate pesticide treatments. CNNs excel in image classification tasks, making them well-suited for detecting diseases in crop images. The algorithm learns hierarchical features and patterns in images, enabling it to discern subtle visual cues indicative of crop diseases. The recommendation is based on the specific disease detected, ensuring targeted and effective treatment.

3.6 *Apriori algorithm*

The Apriori algorithm is commonly used for association rule mining and is not typically applied directly to image-based tasks like disease detection in crops. Instead, Apriori is employed in scenarios involving transactional data or databases, where it helps discover patterns and associations among items. However, Apriori is primarily used for discovering frequent item sets and generating association rules in transactional datasets. It helps identify relationships between different items based on their co-occurrence in transactions.

3.7 *Natural language processing (NLP)*

To ensure effective interaction, Farmer Assisting Chatbots depend largely on NLP. Through processes like named entity recognition, tokenization, and part-of-speech tagging, NLP systems understand user requests. Identifying user intent is crucial; NLP classifies queries into intents, aiding goal determination. Additionally, NLP extracts entities, such as crop names, refining responses. This enhances chatbot understanding, enabling farmers to engage in natural and tailored conversations for seeking advice and information. The formula for calculation is given below. Sentiment Score is equal to Positive – Negative.

Based on established limits, the emotion score can be balanced or classified as positive, neutral, or negative. NLP algorithms generate coherent and contextually relevant responses, ensuring a natural and engaging conversation between the chatbot and the farmer (Figure 4).

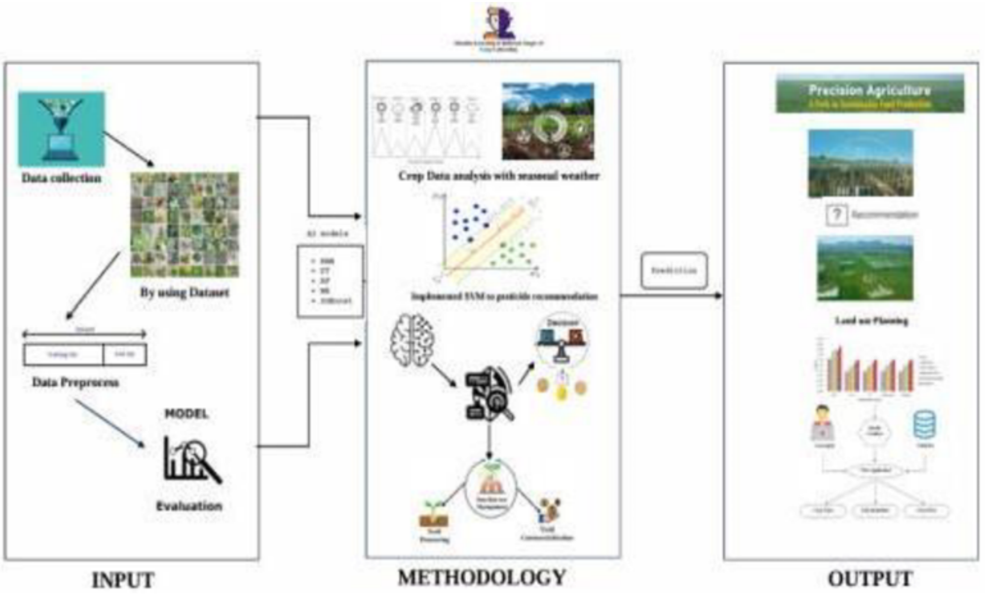

Figure 4. Architecture diagram of smart agrohub.

4 RESULT ANALYSIS

Smart Agro Hub, an innovative farmer assistant project, integrates AI for precision farming and sustainable agriculture. The project's diverse functionalities, including crop recommendation, harvest period suggestion, pesticide and fertilizer recommendations, profit estimation, crop yield prediction, land use planning, and an interactive chatbot, contribute to comprehensive farm management. To analyze the results of the Smart Agro Hub project, we delve into key aspects of its performance and impact. The AI-driven crop recommendation system demonstrated remarkable accuracy in aligning crop choices with seasonal weather conditions. Through data analysis and machine learning algorithms, the system adapted dynamically, optimizing yields based on real-time weather patterns. Farmers reported improved crop selection, leading to enhanced productivity. The system's ability to suggest optimal harvest periods proved beneficial for resource allocation and reducing post-harvest losses. Analysis of historical and real-time data allowed the project to offer precise timelines for harvesting, contributing to efficient farm management practices and minimizing losses. The pesticide and fertilizer recommendations integrated into Smart Agro Hub were tailored to specific crop needs. By considering environmental impact and crop health, the project facilitated sustainable agricultural practices. Farmers reported reduced input costs and minimized environmental impact through targeted recommendations. The inclusion of profit estimation modules enabled farmers to make informed financial decisions. By predicting crop yield and estimating potential profits, farmers could optimize their financial planning.

Post- implementation surveys revealed positive outcomes, with many farmers reporting increased profitability. Post-implementation surveys and data analysis indicated a positive overall impact on participating farmers. Improved crop choices, optimized resource allocation, and enhanced financial planning contributed to increased yields and profitability. Sustainable practices promoted by the project led to a positive environmental impact, aligning with global efforts towards agricultural sustainability. Residual Neural Network (RESNET) Block with Identity skip connection shown in Figure 5.

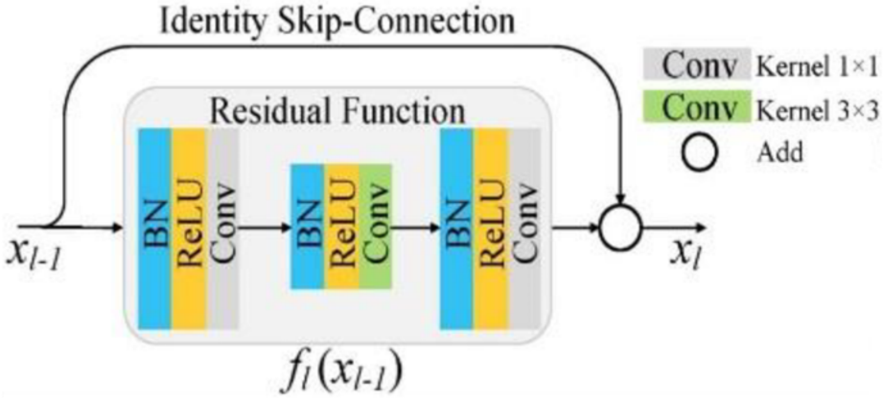

Figure 5. Residual neural network (RESNET) block with Identity skip connection.

5 CONCLUSION

The Smart Agro Hub project lays the foundation for a transformative future in precision farming and sustainable agriculture. The project recognizes multiple options for development and enhancement as developments in technology. By utilizing advancements in machine learning and deep learning, it may be possible to produce business AI models that are more developed. This could improve the precision of yield forecasts, crop recommendations, and system performance as a whole. The Smart Agro Hub signifies a revolutionary shift in farming toward empowerment through technology. Its seamless integration of AI has demonstrated the potential to revolutionize farming practices. The tangible benefits, such as improved yields and profitability reported by farmers, validate the project's success. The inclusion of a user-friendly chatbot has effectively bridged the technology-farmer gap. While achieving notable success, the project's journey is ongoing, presenting opportunities for refinement and integration with emerging technologies. Smart Agro Hub stands as a testament to technology's positive impact on agriculture, laying the foundation for a resilient.

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Enhancing weather prediction and forecasting for agricultural applications using machine learning

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ABSTRACT: The research paper explores the application of machine learning models for agriculture usage in the cases of the LSTM, KNN and Extreme gradient boosting XGBoost. We also develop machine learning models based on historical data of weather station to examine the ability of those models to capture the critical weather patterns that are relevant for agriculture planning and management. The dataset is modified through pre-processing and feature engineering to use for training and evaluating of the machine learning models. To make the comparison, the performance results such as accuracy, MAE and RMSE and the computational efficiency, quality, and performance of machine learning models. The results reveal the differences in the variables to be counted and the selected models are unable to give accurate predictions it was noted. To summarize, the machine learning used. In the agriculture sector has many advantages and strength to address decision making and exemplifies resource allocation, management strategies, yield, and mitigation optimization. In the Research on LSTM, KNN and XGBoost. LSTM is best preferred in predicting and forecasting weather pattern having least and best (MAE and RMSE) value 0.02,0.045 and XGB 13.1 and 4.2. K-nearest neighbours have an accuracy of over 75% and acceptable.

Keywords: Long short-term Memory, KNN, XGBOST and Weather Prediction, Agriculture

1 INTRODUCTION

Weather Prediction and forecasting play a crucial role in agriculture planning since it affects the duration of planting, working days, irrigation, pest control and harvesting. Therefore, if the weather is accurately predicted, farmers will optimize their resources and ensure the reduction of risk due to a disaster, and achieve the yield maximum [1]. The weather forecasters traditionally rely more on the physics-based conventional models dependent only on the weather date available. Nevertheless, the climate process' complexity and climate's characteristics make the model application problematic. In the decades that follow, data-driven technologies, particularly machine maturing, have evolved revolutionized climate forms and forecasting methodologies in their provision of more supple and robust methods of modelling [3]. Machine maturing algorithms are well prepared to recognize circulation and relationships in large amounts of data. Giving them access to big data will help them spot a pattern of bad weather conditions that can aid them in improving forecasting accuracy. Regarding this, three machine learning algorithms have done well in analysing weather forecasting when it comes to short-term memory, which is LSTM, k-nearest neighbour, and boosting gradient, with XGBoost algorithm. XGBoost assembles boosting framework, an efficiency and scalability in handling large-scale datasets and complex relationships. This study seeks to test and compare the performance between LSTM, KNN and XGBoost in

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weather forecasting and its applicability in agricultural field. This research utilizes historical weather data to analyse and compare the three machine learning algorithms; the aim is to evaluate data comparability, computational time efficiency, and ease of use in facilitating agricultural decision-making. By addressing these issues this study will advance the application of higher learning technology to improve the accuracy of agricultural climate, increase knowledge, and make better agriculture.

2 LITERATURE REVIEW

An efficient climate model based on [7]'s exacting work. "The focus is on the use of the Deep learning technology to achieve better weather predictions. The results shown that artificial intelligent models, more, precisely the neural networks CNN or the neural networks RNN, can improve the accuracy of the predictions by identifying patterns in the meteorological data that are too complex for the forecasting engine. Although highly sophisticated deep learning models such as the neural networks RNN and the convolutional neural networks CNN are unable to acquire the information available in good forecasting conditions, far more work is required in several areas to further investigate how the architecture and hyperparameters of deep learning model influence the link's power and the requirement to combining different sources of data is necessary to enhance the model's strength. The general application of machine learning in weather forecasting and climate analysis is found in Machine Learning in Weather 8 Forecasting and Climate Analysis an Applications and Prospects. This material reveals that machine learning models are an effective tool at all levels of climate change: from short-term prediction to climate modelling. However, no studies compare how to interpret the machine learning model in climate to reduce the bias of the model or reduce the uncertainty of the model. The station Weather station special applications of deep neural network in weather forecasting uses Deep Neural Networks. The analysis of inconsistencies in such models will prove how general such models are in different regions and extreme climatic conditions, as well as solve the problem of incorrect data parameters. Adequacy and quality assurance of weather data. Machine Learning for Weather Forecasting [9] is an article in which the use of machine learning algorithms in weather forecasting. The obtained results demonstrate that machine learning techniques can perform as well as traditional weather forecast models and better, in cases where the available computational resources are limited. However, a general assessment across different temporal and spatial scales and the creation of proper procedures containing standardized information in training and interpretation is required [10]. Weather forecasting using random forest machine learning model. [10] is a study in which the use of the random forest algorithm in weather prediction is described. To sum up, while these studies do showcase the promise of random forest models in weather forecasting even with the use of machine learning and deep learning, there is more research that needs to be done so as to address issues related to model interpretation, generalization and reproducibility— as well as scalability and the issue of integrating domain knowledge towards improving prediction accuracy and reliability over time. The current paper will solve the problem by generalization and provide an effective prediction over a long period; we address scalability issues for intraday continuous prediction using LSTM, KNN, and XGboost.

3 METHODOLOGY

In this part, we present the methodology adopted to evaluate the weather forecast performance of LSTM, KNN and XGBoost algorithms. The study is based on a comparative analysis where historical weather data is used for training and testing of the models. Data pre-processing techniques have been applied to deal with missing values and outliers after feature engineering was conducted. This process enhances the model's performance in terms of accuracy and reliability. Details about each algorithm including hyperparameters as well as how they are trained are explained; evaluation metrics like MAE, MSE and Squared ([14] are used to assess model accuracy while sensitivity analysis together with robustness checks are carried out: these help in understanding impact due to parameter variations. Such a detailed methodology paves way for a comprehensive comparative framework which can be considered by decision makers involved in using weather forecasting applications. The main objective of this research is to assess the capabilities that the k-nearest neighbour (KNN), extreme gradient boosting (XGBoost), and long short-term memory (LSTM) have in terms of performance when applied in weather prediction. An analysis study is undertaken in which these three algorithms KNN, XGBoost, and LSTM are compared to each other to determine their efficiency levels in weather forecast. The first step involves obtaining historical weather data for specific temporal coverage from reliable sources like meteorological stations or online repositories. These data contain various meteorological variables recorded at regular intervals (e.g., hourly or daily) including temperature, humidity, pressure, wind speed, precipitation amount among others. Raw data undergoes pre-processing stage aimed at detecting anomalies as well as inconsistencies and missing values which may affect quality of results obtained during analysis.

3.1 *Dataset*

This research paper used dataset from Kaggle having 96456 instances named weather.csv file. Having more than 12 attributes, our focus on temperature, humidity, and daily summary of weather, we train and test our data in this 80%,20% range. We used this dataset for agricultural purpose and try to achieve higher accuracy, we preprocess the data and apply LSTM, KNN and XGboost on following data for comparative analysis (Figure 1).

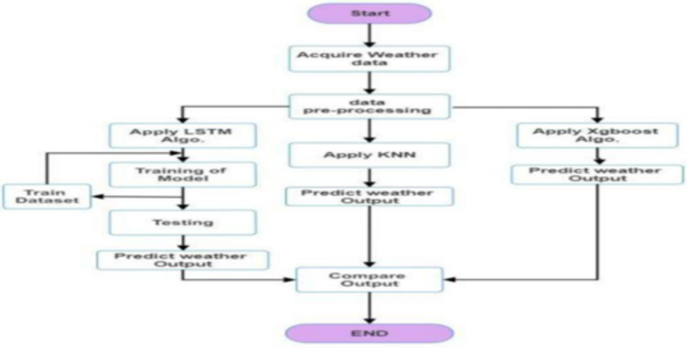

Figure 1. Implementation of LSTM, KNN, XGboost.

3.2 *LSTM (Multi stage short term memory)*

One of the kinds of Multistage neural network is LSTM. That was chosen for its effectiveness in capturing the term reliance which is spread out in data sequences, which will be particularly useful for Realtime forecasting tasks like weather predication. Also, LSTM based model was designed with multiple LSTM layers and predictive thick layers. This involves feeding meteorological history records which in most cases are climatic measurements made at a given point in time (or over a given period). The input data, incorporating the hourly data (up to one <24 h>) is used to train the model. This system lets the LSTM model read patterns and connections in object compared to the prior technique.

$$I_t = tanh \ \ (w_{xi}X_t + w_{hi}H_{t-1} + b) \tag{1}$$

$$C_t = sigm \ (w_{xi}X_t + w_{hi}H_{t-1} + b_j) \tag{2}$$

$$F_t = sigm \ (w_{xf}X_t + w_{hi}H_{t-1} + b_f) \tag{3}$$

where I_t = Input Gate; C_t = Cell State Update; F_t = Forget Gate.

In training the LSTM model, training is accomplished on the training data using either BPTT or other techniques such as the Adam or RMSprop. Validity based measures comprising of Mean Absolute Error (MAE), Mean Square Error (MSE) and R-squared are also determined to assess the efficiency of the model.

3.3 *K nearest neighbour (KNN)*

KNN Algorithm was selected since it is basic and have higher accuracy in the prediction depending on the repetitiveness of sample data. This results in the selection of distance metrics that measures proximity between points in the data set, and the common metrics include the Euclidean distance, Manhattan distance or cosine similarity. The essence of this process is then to choose the nearest neighbour in the feature space to the target data point. The K in KNN stands for neighbours, and it is the number of closest neighbours that must be looked at, when making a prediction. There are ways to obtain “K,” such as employing either the grid search or a competition, about the model’s complexity and accuracy in predictions. During the hypothesis, the prediction area is built by finding the mean value of the “k” neighbouring points in the feature. Apart from that, a weighted factor can also be applied toward the prioritization of nearby people.

3.4 *XGBoost algorithm*

Extreme gradient boosting algorithm works in a manner of imparting lessons to a consecutive series of decision trees each of which is given the task of identifying the rest in the previous tree. This process continues to reduce the prediction while increasing the general accuracy through iteration. The tree structure of the XGBoost model is developed in the similar way as the any other boosting methods such as gradient descent or Newton’s method. For regression functions, the discrete points which are most used are those which minimize the regression; that being the square of the error. There are several strategies like learning rate and tree pruning which is incorporated in XGBoost to avoid over fitting and enhance the model. If testing or cross validation is possible, then adjust parameters of the testing or cross validation regularly to minimize the flaw of both big biases and big variances. Include regression metrics together with MAE, MSE and R-Squared or Mean absolute error. For example, you can use the previous instance 701515. Thus, which will help to avoid overfitting, each of the models is trained on the education set and evaluated on the validation set.

4 RESULT

This work presents the outcomes section of this research paper presenting the performance comparison of two powerful weather predicting models namely Long Short-Term Memory neural networks and XGBoost considering the climatic data of Delhi. In this paper we evaluate the performance of these models to estimate temperature profiles which is essential in decision making processes in different sectors that require accurate weather information. Evaluation also consists of an overview of measures of model performance for the validation process based on the MSE, MAE, and RMSE key performance indicators to derive the model’s predictive abilities. Moreover, visualization methods are used to explain the models’ capability in simulating the characteristics of the atmosphere and their usefulness in providing information for weather prediction. Those models which are useful for stakeholders for getting a reliable weather prediction specifically in relation to the climatic conditions of Delhi (Figure 2).

- A model of LSTM neural network is trained with the historical data of weather in Delhi consisting of four features and its test loss is low, that is [0. This could be since the type that was identified has the potential measures temperature well [025].
- Other factors like mean absolute error (MAE), mean squared error (MSE), root mean squared error (RM S has also an assurance on the credibility of the model and its function
- XGBoost model which is trained with the Delhi's weather data correctly sees the average temperature. The RMSE of the model is [13. 91] and the MAE is [0.002] combined input of these dendrograms for the desired region gives a value of 867, which proposes good results in terms of temperature prediction. Specifically, the accuracy of the Distance and KNN methods is about 75%.

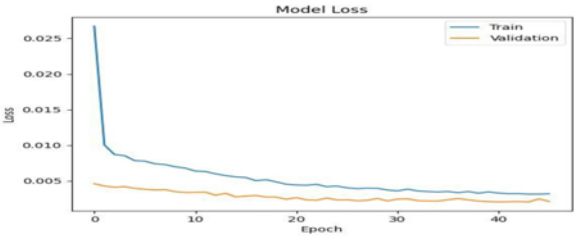

Figure 2. Test loss for LSTM.

Figure 3 shows the accuracy for Predicted Temperature vs Actual Temperature.

Table 1. Comparative analysis of LSTM, XGBOOST and KNN.

Model	MAE	RMSE	Accuracy
LSTM	0.002	0.045	–
XGBOOST	0.149	13.91	–
KNN	–	–	75%

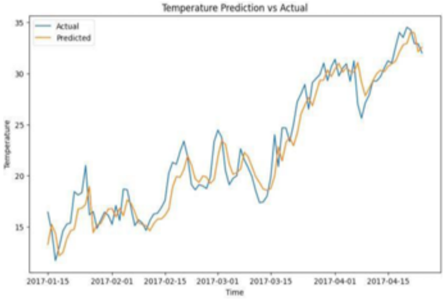

Figure 3. Predicted temperature vs actual temperature.

5 CONCLUSION

In our comprehensive study focusing on weather forecasting using historical data from Delhi, we meticulously compared the performance of three prominent machine learning algorithms: Out of these three algorithms, XGBoost, LSTM, and KNN are the most used algorithms. A comprehensive analysis of the results identified LSTM as the leader, demonstrating great capability in precise modelling of underlying physical characteristics being present in weather data. Despite this, XGBoost performed well in the forecasting issue Nevertheless, LSTM was observed to give better results than both XGBoost and KNN based on MSE and MAE metrics across the several forecasts issues. Thus, the obtained results confirm the effectiveness and high accuracy of LSTM in climate predictions and confirm that LSTM is the best tool for accurate temperature measurements in the process of constructing the dynamic weather model for Delhi. The special application of LSTM expands the power of forecast results that influence the stakeholders of the various sectors with refined decision-making and resource allocation strategies in field conditions. Coating LSTM's best forecast feature, decision makers, contractors, agriculturists, and any other related officials can voluntarily address climate change issues, enhance the handling of natural beasts, and enhance agriculture and general health. Durability. Due to weather risks. This study offers significant contribution to the climate awareness agenda, in so doing providing valuable information regarding the necessity and applicability of the enhanced methods of machine learning in the enhancement of the forecasting capabilities as far as climate change is concerned.

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Plant leaf disease detection by deep learning algorithm

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ABSTRACT: The disease identification using machine learning algorithms is a promising approach for improving plant health and crop yield, and has the potential to revolutionize the agricultural industry. Leaf disease identification by machine learning algorithms is a promising field in plant pathology and precision agriculture leading to better crop yields and increased sustainability in agriculture. In Deep learning based EfficientnetB3 model for various plants leaves. Leaf disease identification by machine learning algorithms involves the use of advanced computational method to automatically identify and classify various types of plant diseases based on the symptoms observed on their leaves. The machine learning algorithms in leaf disease identification offers several advantages over traditional methods improved accuracy, speed, and scalability than the manual inspection to reduce the time-consuming and error-prone, especially in large agricultural fields.

Keywords: Deep Learning Algorithm, EfficientB3, Convolutional Neural Network, agricultural, leaf diseases

1 INTRODUCTION

Agriculture is crucial to the economy, plant leaf disease must be kept to a minimum. Early problem detection is essential, but manual inspections take a long time, which require labor-intensive, and are prone to mistakes. With help of Artificial intelligence (AI) extract leaf color, shape, or texture data, thus aiding the detection of infections [1,2]. The main crops grown in India is susceptible to a number of illnesses at different phases of its development. It typical task to manually identify diseases [3,4]. Machine learning algorithms are developed for object detection, classification and many image processing applications in real time observations. In this proposed method, the leaf diseases are detection by using machine learning algorithms.

1.1 *Literature survey*

Shima Ramesh *et al.* [2018] introduced ML algorithm for plant decision, which algorithm for identification of abnormalities at plants in natural environment. To prevent occlusion of the image is typically taken with a plain background by ML algorithms identify the plant diseases [5]. P. R. Rothe *et al.* [2015] introduced a method f to detect on decease of Cotton Leaf by Pattern Recognition Techniques with Back Propagation CNN. In this process,

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multiple class problems are solved without complex explicit function to adjust to the data for classification [6]. Caglayan *et al.* [2013] suggested method for Plant Recognition Approach Using texture features in Leaf data to classify the leaf color and physical shape [7,23] Godliver Owomugisha *et al.* [2014] proposed "automated vision technology for bacterial decease on leaf by color histograms techniques, which are extracted for color transformed images and classification can be done by nearest neighbors and Naïve bayes and SVM classifier [8]. S. Yun, W. Xianfeng *et al.* [2015] introduced a method for crop disease recognition "PNN based crop disease recognition, here features extracted from the environmental condition-based disease image color, shape and texture [9,22]. Pushkara Sharma *et al.* [2020] introduced a "Classification of leaf deceases with image processing technique. After preprocessing techniques k-means clustering and comparing classifiers are done for identification of the objects [10].

2 MACHINE LEARNING AND DEEP LEARNING

ML Algorithms are implemented with statistical procedure to implanting patterns with data and make predictions based on patterns. These algorithms can be supervised, unsupervised, or semi-supervised, depending on whether the data used to train them is labeled or not. The selected training samples are required for supervised learning in ML algorithm on labeled data, which are provided both input as well as output. [13,14]. The algorithm learns to make predictions by identifying patterns in the input data that correlate with the desired output. There are many reasons why machine learning is used in various industries and applications. Here are some of the key reasons. Machine learning can automate complex and time-consuming tasks that would otherwise require human intervention. For example, in a manufacturing plant, machine learning algorithms can be used to detect defects in products on the assembly line, allowing for immediate intervention and correction [11,12].

3 DEEP LEARNING TECHNIQUES

Artificial neural networks (ANNs) are a key component of deep learning approaches. One kind of ANN is the recurrent neural network (RNN), which accepts input in the form of sequential or time series data. For DL (Deep Learning), the CNN is main net-work design that is used for special functions in data processing. The majority of computations hap-pen in the convolution layer in CNN. A subsequent convolution layer could come after the first convolution layer. Inside this layer performs convolution process to determine the feature, which is present in data set. The result of convolved feature is being conned for certain pattern. The image is ultimately converted to numerical values in this layer so that the CNN can recognize them and identify the necessary patterns.

4 PROPOSED METHOD

Efficient Net B3: In 2019, Tan and Le. Suggested The CNN architecture proposed, which is subset of a family Efficient Net models (B0, B1, B2, B3, B4, B5, B6, and B7) to achieved state-of-the-art performance variety of highly efficient computer vision tasks in terms of size and computational requirements. The architecture operated with the compound scaling method. This scaling method uniformly performs the scaling operation of the depth, width, and resolution of a baseline network to find the optimal balance between computational resources and accuracy.

The B3 variant has 12.2 million parameters and obtained optimum values of accuracy on the ImageNet dataset with top-1 accuracy. EfficientNet-B3 performs the depth wise

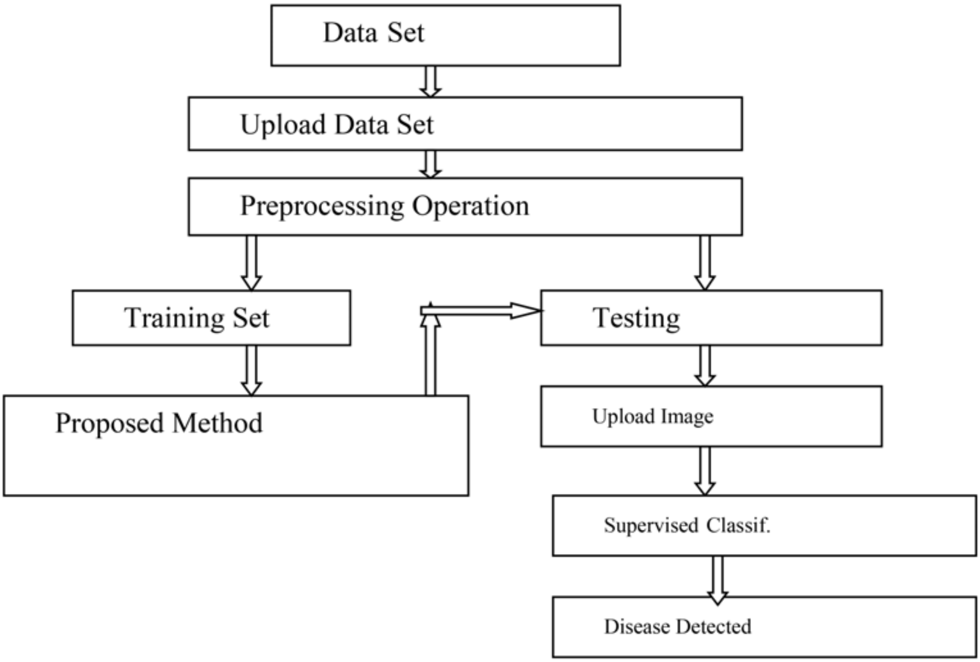


Figure 1. Flow chart for proposed method.

operations and separable convolutions for reduction of the computational cost and parameters, linear bottleneck layers, which help to capture more complex features. It also includes a novel scaling method for the activation function, which helps to improve the model's accuracy (Figure 1).

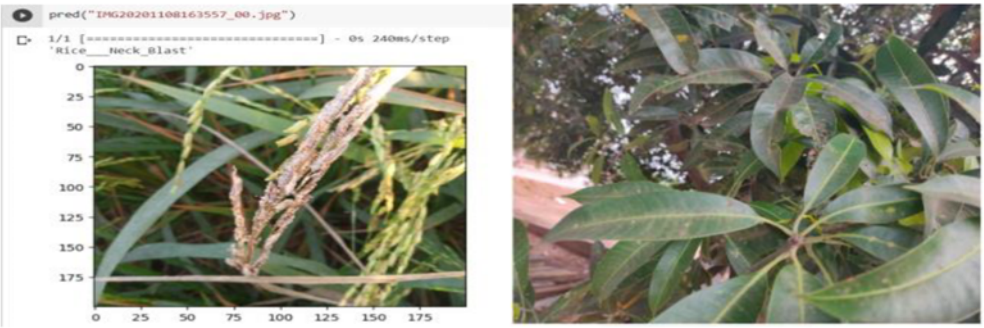
5 CREATE DATASET

In this experiment, collecting dataset of internet source Kaggle website, which is mainly enveloped for the various datasets. Some more of data collected from various places, which are effected by some deceases. By adding updated copies to already existing data or by generating new synthetic data from existing data, data augmentation techniques are used to expand the amount of data.

Some of leaf with diseases are collected from Sasi Institute of Technology & Engineering campus and verified accuracy levels with various standard algorithm techniques. Figure 2(a) shows the corn leaf. This leaf effected with corn rust disease. On both leaf surfaces, common rust causes elongated, rust-colored to dark brown pustules. Figure 2(b) represents the potato effected Early Blight, which automatically degrade crop of potato.

In this paper, Corn Common Rust leaf (59) it gives 100 percent of accuracy with no errors. Corn Gray leaf spot gives one error it shows Corn Northern leaf blight. Corn Healthy gives 100 percent results. Potato Healthy gives 100 percent accuracy with no errors. In the above fig we have 33 errors and it gives 94.92 accuracy. Rice Brown Spot gives the most errors when compared to the others.

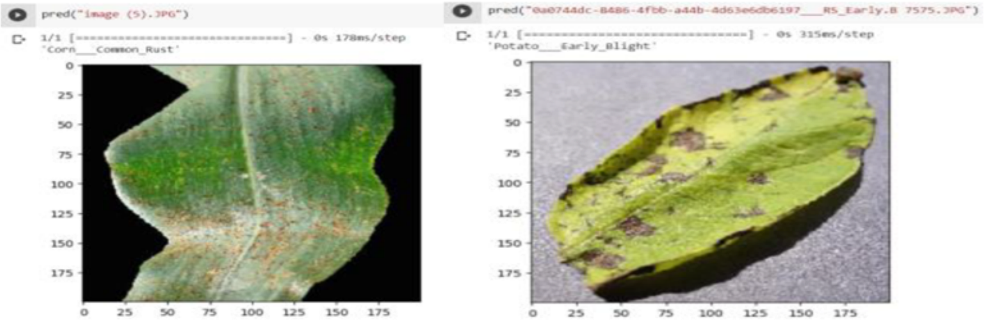
From Table 1 accuracy compare level with standard classification algorithm SVM and K-means clustering algorithm. The proposed method gives sophisticated results compare with other methods.



```
pred("IMG20201108163557_00.jpg")
1/1 [==============================] - 0s 240ms/step
'Rice___Neck_Blast'
```

(a) (b)

Figure 2. Corn Leaf (a) and Potato leaf (b).



```
pred("image (5).JPG")
1/1 [==============================] - 0s 178ms/step
'Corn___Common_Rust'
```

```
pred("0a0744dc-8486-4fbb-a44b-4d63e6db6197___RS_Early.B 7575.JPG")
1/1 [==============================] - 0s 315ms/step
'Potato___Early_Blight'
```

(a) (b)

Figure 3. Rice leaf (a) and Mango Leaf (b).

Table 1. Classification report.

S.No.	Method	No. of Samples	Accuracy
1.	K-means clustering Algorithm	250	89.23
2.	SVM	250	88.23
3.	Principal Component Analysis	250	82.43
4.	Proposed method	250	94.92

6 CONCLUSION AND FUTURE WORK

The diseased leaves are classified using the dimensional reduction based convolution Neural Network. The dimensional based CNNs are trained by dataset of labeled images, where the network learns to recognize patterns and features that are associated with the images and a portable CNN architecture Efficient Net is used for classification of diseased and healthy leaves. Total of 4 different plants are taken here and the CNN is used to classify 10 types of diseases with highest accuracy. It can also classify the healthy leaves. The average accuracy among these plants is 94.92. This dimensional reduction method also implement for medical application and large multispectral data for various application also. ML algorithm very helpful for analyzing the cloudy data with less complexity and obtain maximum efficient results compare with other standards methods.

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Smart health monitoring system using IoT and machine learning

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ABSTRACT: The fundamental element of people's needs is health. Humans face a haul of surprising death and plenty of diseases because of varied diseases resulting from a lack of treatment to patients at the right time. By seamlessly integrating the Internet of Things (IoT), Machine Learning, and Shapley Additive Explanations (SHAP), this study presents a revolutionary paradigm for health monitoring. The system collects real-time health data via IoT devices. Machine learning approaches are used for comprehensive health pattern analysis, and SHAP values aid in assessing interpretability and feature importance. The Random Forest model achieved an excellent accuracy of 60% in the experiments, demonstrating a substantial breakthrough. This study demonstrates the efficacy of combining IoT with machine learning, highlighting its potential for developing health monitoring systems. The method not only produces accurate forecasts, but it also provides essential insights into the critical elements impacting health outcomes, hence helping to the growth of tailored and data-driven healthcare solutions.

Keywords: Internet of Things (IOT), Machine Learning, Temperature Sensor, Pulse Sensor, WIFI Module, Arduino, ThingSpeak

1 INTRODUCTION

The Internet of Medical Things (IoMT) revolutionizes healthcare by linking objects with sensors and information technologies to enhance patient care, research, and monitoring. Remote monitoring of chronic diseases using IoT and wireless solutions promises to improve billions of lives. IoMT communicates via sensors, gateways, and networks, crucial for disease management and healthcare quality. By 2025, a trillion-dollar investment will drive the adoption of wearable devices, networked sensors, and data analytics, boosting accessibility, personalized care, and health promotion. Despite challenges like under-resourced hospitals and disparities in care, IoMT's continuous data collection and analysis can transform healthcare delivery and efficiency.

2 LITERATURE REVIEW

An overview of remote patient health monitoring system [1]. It discusses the use of various sensors and IoT devices to monitor the health parameters of patients. The system is designed to capture data and transmit it over the internet for analysis, allowing for remote monitoring of patients' health. A real-time patient monitoring system working with Arduino and Raspberry Pi boards, temperature sensors and pulse oximeters [3]. Data is passed to authorized devices through a cloud server, demonstrating aspects such as Raspberry Pi, Arduino Uno and MQTT protocol. Results illustrate that successful data is conveniently presented on smartphones and laptops with MQTT Lens. Research work [4] presented a detailed study of patient health monitoring system with the help of IoT technology and cloud-based infrastructure. The data is collected from health users through IoT devices then this information

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gets transmitted processed and stored in the cloud for continuous monitoring and analysis. The process of building a healthcare monitoring system based on IoT [5], cloud computation and container-based virtualization by using edge devices. The main components of the system included Internet of Things IoT for data collection, cloud-based infrastructure for storage and processing data, container based virtual environments on edge devices to optimize deployment efficiency. It makes the system more flexible and scalable when using containerization in edge devices. This paper overall discusses the design, implementation, and potential advantages of this integrated healthcare monitoring system, showcasing advancements in the field. Yang et. al. [6] created a wearable system for ECG monitoring within the scope of smart healthcare. This system is made up with IoT and cloud-based technologies. The wearable device is predicted to record ECG. The wearable device is expected to capture ECG data, which is then transmitted through IoT connectivity to a cloud infrastructure for storage and analysis. The article [7] discusses the key components of architecture designed for smart healthcare systems that incorporates Internet of Things (IoT) in healthcare, and the benefits of incorporating IoT awareness. Their aim is to provide a foundation for developing intelligent and interconnected healthcare solutions. The work [8] proposed a method for ubiquitous data access in an Internet of Things (IoT)-based information system specifically designed for emergency medical services. The implementation [9] of an IoT-based smart nursing system for patients who are bedridden. In [10] presents a portable health monitoring system that helps patients have remote access to the healthcare providers and monitor their wellbeing, especially in COVID-19 time. It is made up of Raspberry Pi, Node-Red, ThingSpeak and also sensors which include LM35 temperature sensor, AD8232 ECG Sensor and MAX 10 pulse oximeter to measure key health parameters which allows doctors or guardians to monitor patients remotely. The data gathered by the sensors is then sent to a cloud-based platform for monitoring in real time and can also be used when offline. Article [11] proposes a model for a smart healthcare system leveraging IoT-cloud technology. It outlines the use of sensors connected to a Raspberry Pi to monitor patients' symptoms, with data transmission to a cloud server for access by healthcare professionals. The challenges of implementing IoT in healthcare are discussed, and a comparison between the use of docker containers and virtual machines in the proposed model is provided. Research work [12] discuses about deploying IoT based real-time pulse and temperature monitoring systems in healthcare. Utilization of sensors, a Raspberry Pi microprocessor, and a cloud platform for continuous monitoring on patients' vital statistics and live data presentation and also Proteus for simulation purpose was used in [13].

3 METHODOLOGY

3.1 *Proposed method*

Figure 1 shows the proposed system which includes Arduino Uno, LM35 Temperature Sensor, Pulse Sensor, AD8232 and ADXL 345. The patient's heart is the Arduino Uno. The sensors capture the data which is then relayed to Arduino Uno. Arduino Uno processes the data and sends it to the ThingSpeak cloud platform. Now, the data or alerts can be visualized using ThingSpeak platform in case specific conditions are met in monitoring system.

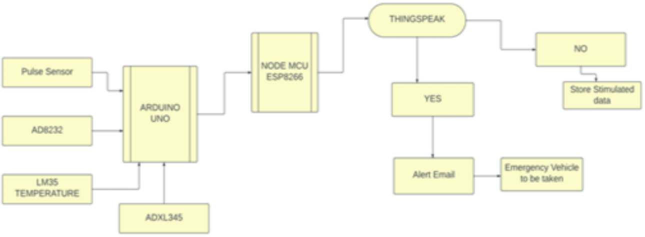

Figure 1. Architecture of the health monitoring system.

Table 1. The components used for the IOT-based health monitoring system.

Model	Specifications
Node-MCU ESP8266	32 pin Wi-Fi module with built-in Wi-Fi, enabling wireless connectivity and easy integration for various Arduino projects, home automation, and sensor applications. It can be programmed using the Arduino IDE
LM35	5v-3 pin model is a temperature sensor widely used for accurate temperature measurement in electronic circuits.
ADXL345	5v-5 pin model is utilized for fall detection in wearable devices and elderly care systems by sensing sudden changes in acceleration, triggering alerts or safety mechanisms for potential fall incidents
Pulse sensor	5v-5 pin model is employed for real-time heart rate monitoring providing a non-invasive way to measure and track a person's pulse
Ad8232	3.3v-5 pin model is an ECG sensor used to measure and monitor electrocardiogram signals, detecting heart activity for health monitoring devices and medical diagnostics

The components used for the IOT-based health monitoring system is shown in Table 1. Figure 2 represents the results obtained from dashboard displaying four different health monitoring systems. Every system has two graphs. The bottom graph depicts accelerometer data, while the top graph depicts a heartbeat plot over time. The bottom right system shows irregular accelerometer data, which may imply movement or activity, while the top left system looks to have a fast heart rate. The other two systems had lower heart rates and less variability in accelerometer data. In general, two of the four systems exhibit elevated heart rates or activity, while the other two are quite tranquil. For each system, there is a top graph displaying heart rate over time and a bottom graph displaying accelerometer data, which most likely depicts motor activity. Framework This system's heart beat appears to be high and fluctuating regularly. Additionally, there are occasional fluctuations in the accelerometer data that indicate motion or activity. System 2 appears to be steadier, with a lower heart rate than System 1. The accelerometer data also shows less fluctuation, indicating that there is less movement or activity. System 3 has a modest and stable heart rate, similar to System 2. The accelerometer data shows little variations. System 4: This system's heart rate is high and fluctuates regularly, similar to System 1. The accelerometer data also reveals occasional variations, which indicate movement or activity. Overall, the dashboard indicates that two of the four systems have elevated heart rates or activity, whilst the other two are generally tranquil.

4 RESULTS AND DISCUSSION

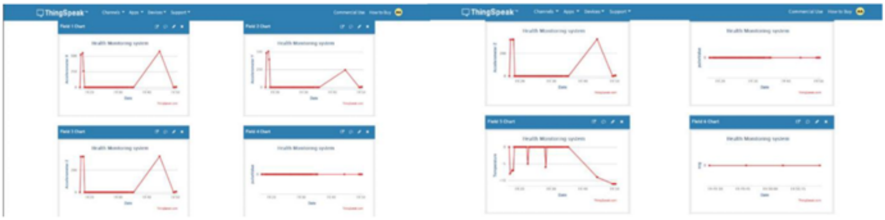

Figure 2. Thing speak result.

4.1 *Machine learning*

Thirteen machine learning models were used, with regression models being Linear regression, ridge regression, lasso regression, decision tree regressor, random forest regressor, k-neigbours regressor, support vector regressor and gradient boosting regressor. For regression models the performance metrics are MSE, RMSE, MAE and MAPE. Classification models are decision tree classifier, random forest classifier, kneigbours classifier, support vector classifier and gradient boosting classifier and their performance metrics is accuracy, precision, recall and F1-Score.

Table 2. Regression models and their corresponding performance metrics.

Model Names	MSE	RMSE	MAE	MAPE
Linear Regression	684.38	26.16	23.31	31.31%
Ridge Regressor	684.37	26.16	23.31	31.31%
Lasso Regressor	684.75	26.17	23.34	31.36%
Decision Tree Regressor	798.10	28.25	25.09	33.01%
Random Forest Regressor	785.72	28.03	24.89	32.75%
K Neighbors Regressor	874.02	29.56	25.08	33.83%
SVR	700.21	26.46	23.77	32.30%
Gradient Boosting Regressor	801.82	28.32	25.09	32.97%

Table 2 shows that the Pulse Rate predictions made by the linear regression model have an average error of 26.16. As anticipated, the results resemble those of linear regression. In the event that the features exhibit multicollinearity, ridge regularization may be beneficial. MSE and RMSE are marginally higher than in linear regression. It's possible that Lasso is penalizing some features more severely. When compared to linear models, the MSE and RMSE are higher, indicating overfitting of the training set. The Regressor for Random Forest. The advantage of an ensemble approach is demonstrated by the results, which are marginally better than a single Decision Tree. Greater errors in comparison to linear models suggest that the dataset may not be a good fit for the straightforward k-nearest neighbor method. Linear models can be compared to MSE and RMSE.SVR can be sensitive to hyperparameter tuning. Results are similar to the Decision Tree Regressor. Gradient Boosting might require further tuning to improve performance (Figure 3).

Table 3. Classification models and their corresponding performance metrics.

Model Name	Accuracy	Precision	Recall	F1 Score
Decision Tree Classifier	57.38%	57.82%	57.38%	57.54%
Random Forest Classifier	60.66%	62.94%	60.66%	61.28%
K Neighbors Classifier	39.34%	40.53%	39.34%	39.67%
SVC	44.26%	50.94%	44.26%	35.44%
Gradient Boosting Classifier	49.18%	52.97%	49.18%	48.82%

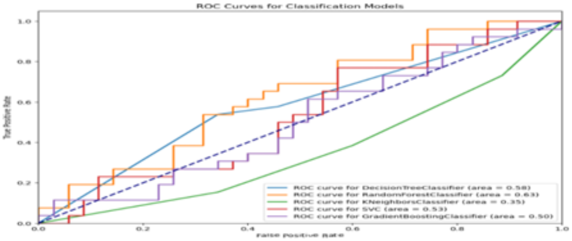

Figure 3. Roc Curve for the classification machine learning models.

Table 3 shows that the Decision Tree Classifier is making predictions with an accuracy of 57.38%. Higher accuracy, precision, recall, and F1 score compared to the Decision Tree Classifier. Random Forests outperform others; K-neighbors has lower accuracy. SVC and Gradient Boosting are moderate but need tuning for better performance. Figure 4, 90.5,690.6,90.7,90.8 plot shows the impact of temperature and pulse rate on the output of the prediction model. Figure 4 shows the summary Plot, dependency Plot, decision Plot and waterfall Plot.

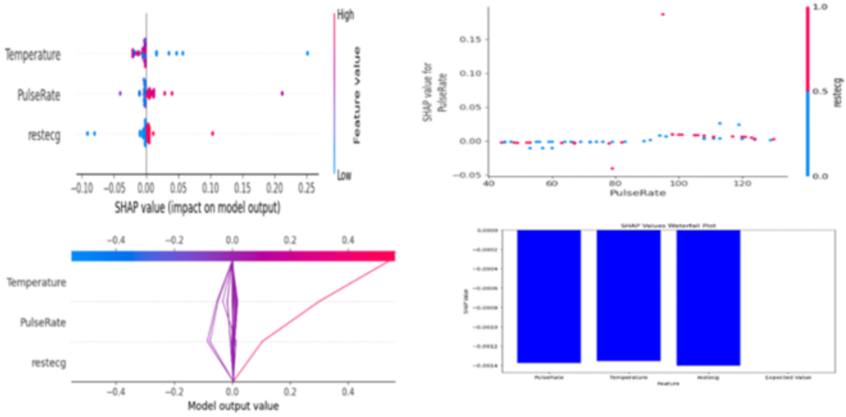

Figure 4. Summary plot, dependency plot, decision plot & waterfall plot.

5 CONCLUSION

This research presents a novel approach to health monitoring, integrating IoT, machine learning, and Shapley values, with a focus on transparency and interpretability. The application of a Random Forest machine learning model yielded a commendable accuracy of 60%, showcasing the system's potential for robust health assessments. The incorporation of Shapley values not only augmented the accuracy but also provided valuable insights into the model's decision logic, enhancing trust and understanding. Despite achieving a significant milestone, there remains room for improvement, and future work will explore model refinement, hyper parameter tuning, feature engineering, and the incorporation of additional data sources to further enhance predictive capabilities.

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The role of artificial intelligence in computer-aided drug design

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ABSTRACT: The process of drug development is very time consuming and expensive. It takes more than a decade to develop a new drug. Computer aided drug design (CADD) is the use of computer which can help in identification of targets and in identification and selection of leads. Artificial intelligence (AI) in CADD has revolutionized the pharmaceutical industry by facilitating the drug discovery process. This article basically talks about the AI methods and tools that adds on to the features that are helpful in making the drug development process much easier than the traditional one. The contribution of AI in CADD comprises of various stages such as molecular docking, virtual screening, and lead optimization. Efficient analysis of vast chemical databases, predicting drug target interactions, and generating novel molecules with desired pharmacological properties are enabled by AI. The fusion of AI and CADD holds promise in overcoming traditional challenges, significantly reducing time and costs involved in drug development while promote the creation of safer and more efficacious medication.

Keywords: Artificial Intelligence, Computer Aided Drug Design, Pharmacy, Drug, Machine Learning

1 INTRODUCTION

The process of creating new medication is time-consuming and costly. To reduce these difficulties and barriers, scientists across the world turned to computational methods like molecular docking and virtual screening, which are also referred to as conventional methods. [1] CADD involves the use of computational method, including AI and machine learning to assist in the discovery of new drug and its design. Computational approaches guarantee a systematic assessment of the various molecular attributes like pharmacokinetic parameters, selectivity, physicochemical properties, side effects and bioactivity at the speculative level, in addition to producing optimized molecules with desired properties in silico. [2] John McCarthy first used the phrase “Artificial intelligence” in 1956 at the Dartmouth conference to refer to “the science and engineering of making intelligent machines”. Since AI is time and money efficient, it has emerged as a tremendously successful and demanding technology. [3] AI has the power to eliminate all the obstacles in the field of CADD and to strengthen the function of computational techniques in

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drug development. Machine learning can help optimize the chemical properties of lead compounds to enhance their efficacy, safety, and bioavailability. AI can analyse patient data to identify subgroups with specific genetic or molecular characteristics, enabling the development of targeted therapies tailored to individual patients. [13–15] AI and machine learning can automate the analysis of large datasets generated by high throughput screening, accelerating the identification of promising drug candidate. AI can assist in designing more effective and efficient clinical trials by analysing the historical data, optimizing patients' selection criteria, and predicting trial outcomes. The integration of AI and machine learning into pharmacy CAD design holds great potential for streamlining the drug discovery process, cutting expenditures, and raising the possibility of successfully introducing novel, efficient medications to the market. [4].

2 LITERATURE REVIEW

Artificial intelligence plays a great role in computer aided drug design various machine learning based tools and method make the drug development and repurposing, economic and less time consuming. The information from different articles which mention about different AI based tools and methods like ProPose, ORGANIC, DeepTox, ProTox-II, Driver ML, DL-based tool, Vienna Liver Tox etc. which have different features like rank molecules according to their similarity of their interaction with ligand, creating molecules with desired properties, toxicity prediction, predict driver gene of cancer, identify pharmacokinetic properties etc. which are helpful in making the drug development and repurposing less time consuming and reduce cost. [5–12] In 2015, Brown.N.ORGANIC developed a tool for molecular production designed to assist in creating molecules with specific characteristics. [5] In 2016, Mayr A. *et al.* introduced DeepTox, utilizing a DL algorithm for toxicity prediction. [6] In 2018, Banerjee P. *et al.* developed Pro Tox-II for the same purpose. [7] In 2019, Han Y. *et al.* presented DriverML, pinpointing cancer-related driver genes. [8] In 2020, Zhu H. introduced Deep Chem, a Python-based AI method employing DL for molecular recognition in drug discovery workflows. [9] In 2021, Lennox-Chhugani N. *et al.* conducted a breast-imaging-specific study revealing positive patient feedback on AI-assisted screening mammograms. [10] In 2022, Halamka J. *et al.* proposed an ML approach to enhance surgical care with AI. [11] Finally, in 2023, Agrwal R. *et al.* discussed various AI strategies for healthcare. [12].

3 METHODOLOGIES

Figure 1 represents the methodology of this article. Research papers from 2005 to 2023 are selected based on role of different computational techniques (AI, ML, DL) in drug designing and other applications of computer aided drug design.

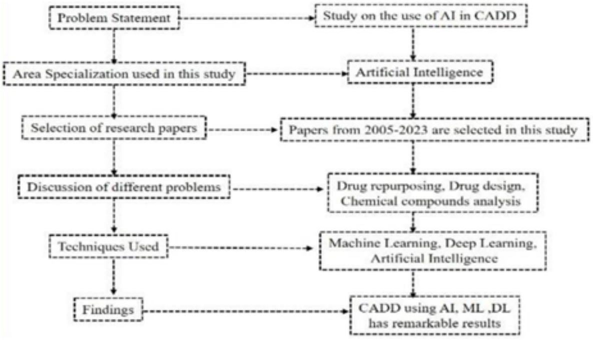
Problem Statement
Study on the use of AI in CADD
Area Specialization used in this study
Artificial Intelligence
Selection of research papers
Papers from 2005-2023 are selected in this study
Discussion of different problems
Drug repurposing, Drug design, Chemical compounds analysis
Techniques Used
Machine Learning, Deep Learning, Artificial Intelligence
Findings
CADD using AI, ML ,DL has remarkable results

Figure 1. Methodology used in this article.

4 CHALLENGES

The pharmaceutical business currently faces two main obstacles when creating new drugs: rising costs and declining efficacy. The primary concern surrounding the integration of these technologies is the potential loss of jobs and the strict regulations required to integrate artificial intelligence. To design a medication that is both effective and has good ADMET characteristics and target activities, lead optimization is also a difficulty. Nevertheless, these factors are autonomous and occasionally contradict each other. One way to overcome this issue is to further enhance the model by optimizing each parameter independently. Being a governing aspect in model creation, molecular representation presents additional challenges.

4.1 *Data quality and quantity*

AI algorithms require large, high-quality datasets to effectively learn and make accurate predictions. Obtaining comprehensive and reliable data, especially in the domain of drug design, can be challenging due to the complexity and variability of biological systems.

4.2 *Model interpretability*

Deep learning algorithms are among the many AI models used in CADD that are sometimes regarded as “black boxes,” making it challenging to comprehend the logic underlying their predictions. Interpretable AI models are crucial for gaining insights into the underlying mechanisms of drug interactions and facilitating regulatory approval processes.

4.3 *Biological complexity*

Biological systems are incredibly intricate, and predicting the behaviour of drugs within these systems accurately poses a significant challenge. AI algorithms must account for various factors, such as protein structure, molecular dynamics, and cellular interactions, which adds complexity to the drug design process.

4.4 *Computational resources*

AI-driven drug discovery often requires substantial computational resources for tasks such as virtual screening, molecular docking, and molecular dynamics simulations. Access to high-performance computing infrastructure can be a limiting factor for researchers, particularly those from resource-constrained environments.

4.5 *Regulatory hurdles*

Incorporating AI-driven methodologies into the drug development pipeline necessitates adherence to regulatory standards and guidelines. Ensuring that AI-generated predictions are reliable, reproducible, and compliant with regulatory requirements is crucial for gaining approval for new drug candidates.

4.6 *Ethical and legal considerations*

AI-based drug design raises ethical and legal concerns regarding issues such as patient privacy, data security, and intellectual property rights. Addressing these concerns requires the development of robust ethical frameworks and legal regulations to govern the use of AI in pharmaceutical research.

4.7 *Integration with experimental validation*

Even though AI algorithms help expedite the early phases of drug discovery, experimental validation is still necessary to verify the safety and efficacy of possible therapeutic candidates. Creating a link between experimental outcomes and computational predictions is essential to converting AI-driven insights into real-world therapeutic interventions.

5 CONCLUSIONS

From enormous amounts of pharmaceutical data, artificial intelligence (AI) technology particularly the deep learning method-can be utilized to learn pharmacological expertise (such as chemical structure and QSAR). The acquired knowledge can then be used to find and create molecules with the necessary characteristics, to enhance the molecular features, and to increase the likelihood that the molecule will be approved for clinical use. Because artificial intelligence (AI) is still far from perfect and cannot analyse all data, merging human and machine intelligence is a useful tactic. The ongoing trend suggests that as comprehensive software packages for research and deployment, along with clear documentation, continue to advance, these methods will increasingly become accessible in the foreseeable future. The healthcare industry confronts numerous complex challenges, including escalating drug and treatment expenses, demanding urgent and significant interventions. Integrating AI into pharmaceutical manufacturing holds promise for crafting tailored medications with precise dosages, release profiles, and other essential attributes tailored to individual patients' requirements.

6 FUTURE SCOPE

The future potential of AI in Computer-Aided Drug Design (CADD) offers a compelling prospect of substantially expediting the drug discovery process. AI algorithms possess the capability to analyse extensive sets of biological and chemical data, facilitating the documentation of potential drug candidates with greater efficiency compared to conventional methods. Precision medicine will be a key focus, with AI considering individual genetic variations, lifestyle factors, and disease profiles for personalized drug design. Multi-modal data integration, incorporating genomics, proteomics, and structural biology, will provide a more comprehensive understanding of disease mechanisms. AI's predictive modelling capabilities will be crucial in early identification of drug toxicities, reducing costs and improving safety in drug development. De novo drug design, facilitated by generative AI models, will enable the exploration of novel chemical space for innovative therapeutic compounds. Automation of repetitive tasks, such as virtual screening and molecular docking, will free up researchers to emphasis on more complex aspects of drug design. Collaborative efforts between AI systems and human experts will enhance decision-making processes in drug discovery. For AI-driven medication design to comply with privacy, bias, and visibility concerns, ethical considerations and legal frameworks are crucial. Overall, the integration of AI in CADD holds the potential to revolutionize pharmaceutical research, making drug development more efficient, personalized, and impactful.

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Using machine learning algorithms to predict crop production and recommend fertilizer

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ABSTRACT: A significant problem in the realm of agricultural endeavor is yield prediction. Anyone involved in agriculture (a farmer) is curious to know how much produce is too expected. Years back, yield output prediction Were Made based on farmers' prior experiences. Considering the information at hand, the yield forecast is a significant problem that has to be resolved. Techniques for machine learning are one method to overcome that problem. Agriculture uses a variety of Machine Learning (ML) algorithm to Jude the crop production for following year and evaluates their performance. Based on previously gathered data, a system to estimate crop output is proposed and put into practice in this work. The purpose of this research is to develop a prediction model to be used to predict the future of agriculture. It briefly explains how machine learning can be used to predict agricultural yield.

Keywords: Agriculture, Crop Prediction, Random Forest (RF), SVM, Machine learning (ML), Soil Nutrients

1 INTRODUCTION

The Indus Valley Civilization is where Indian agriculture's long, illustrious, and fascinating history started. The Great Anicut Dam (1st–2nd century AD) on the Kaveri River is one the oldest dams in the world [1]. Around 9000 BC, early cultivation and domestication of plants and animals marked the beginning of agriculture in India. Use agricultural tools and follows to swiftly adjust your life. Two monsoons each year bring in two harvest.

Indian commodities swiftly spread around the world thanks to established trade networks, whereas items from other countries were also imported to India. plants and disrupting the economics of other countries that support Islam. By controlling the soil and water, it is designed to create consistent growth. Even though the economy is now in recession, the independent Republic of India Different Soil Type in India In the past, soils were mostly divided into two categories: Urvara (fertile) and Usara (sterile). Vasily Dokuchaev created the original scientific categorization of soil. The Indian Council of Agricultural. India's soils have been divided into 8 separate types by research (ICAR). As follows Alluvial soil, Second, Black Cotton Soil, Yellow and Red Soil, Mountainous or Forest Soil, Arid or Desert Soil, Laterite Soil, Alkaline and Sodium Soil, Marshy and Peaty Soil.

As previously indicated, ICAR classifies soils into eight different categories, although some Indian soils, such as Karewa soil and Sub-Montane literature survey, are also included. As previously indicated, ICAR classifies soils into eight different categories, although some Indian soils, such as Karewa soil and Sub-Montane literature survey, are also included. 1) Classification of Soils: Details on soil nutrients may be used to classify soils. Random forests as well as s v m are 2 M L forms use to categories soils. average, ultimately % accuracy are

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divided and displayed by both methods. Crop data, nutrient data, and resource help to provide output. The Random Forest – supported vector machine techniques were recently introduced to these concepts. Based on the input that is available, these mathematical models will estimate the yield. Fertilizer Recommendation: Information about crops, locations, and nutrients can be used to make fertilizer recommendations. That suggests compatible crop And the necessary fertilizers for every crops related work. Shivant Ghosh, (2014) The machine learning framework used in this study is broken down in 3 parts sampling (various Soil that contain same amount Of attributes but various settings), back propagation algorithms, and Weight update. P.Vinciya (2016) This essay largely analysed agriculture, including organic and inorganic farming, plant cultivation through time, good returns and data loss, and Real Estate commercial land in a particular area. Finding appropriate information model which Achieve high precision and high consensus in area of yield expectation abilities is goal of this endeavour.

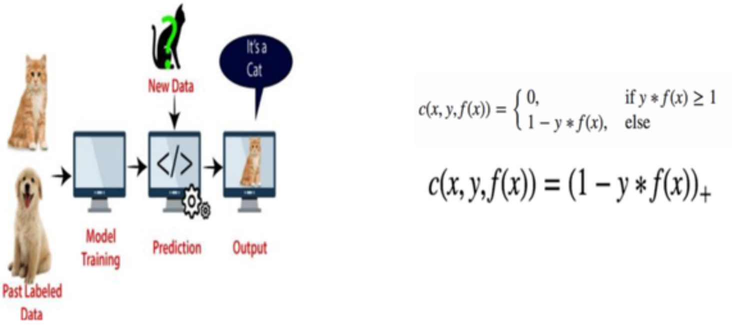
Zhihao Hong (2016) In order to collect and demonstrate information, this research suggests an information-driven paradigm for PA replies. For example, soil moisture, a crucial component of the yield growth cycle, is used to demonstrate the dimensions of the information driven approach. In the side of accumulation, responsive remote sensor is constructed with the intention of utilizing soil dampness sensor to catch the elements of soil dampness. To demonstrate the prototype's use and the sensors' response, it is tested on field dirt. Based on identical soil and natural properties that our sensor hub can acquire, the structure forecasts soil wetness n days in advance. Sabri Arik-(2016) article presents a method for determining the properties of soil samples using a range of quantifiable spatial and spectral attributes. The approach is predicated on the Savitzky filter pre-processing and the extreme learning machine (ELM), a relatively recent development in single hidden layer forward networks (SLFN) learning technology.

Vaneesbeer Singh (2016) In order to forecast Varity of the crop based on condition of the macro- & micronutrient in the dataset, this work proposes an approach that makes use of many MACHINES LEARNING (ML) approaches. The variables covered in the data include the macronutrients (pH, Oc, N, P, K and S) and micronutrients (Zn, Fe, Mn, Cu) observed in an experiment obtained from various regions of the Jammu district. A machine learning (ML) technique is then utilized to forecast the type of yield after investigation. As anticipated, the category would clearly display crop yield. The crop yield prediction problem is classified as a classification problem using various classifier techniques. Using a nave bayes and decision tree technique, E. Manjula (2016) looked into the nutrient's nitrogen, phosphorus, potassium, calcium, magnesium, sulphur, zinc, and other soil additives. The performances of the classification algorithms are compared based on accuracy and execution time.

Research done up to this point has only focused on applying data mining techniques and various soil parameters to predict crops. The recommendation for fertilizer is not taken into account. In order to predict crop production base on soil nutrient and crop production Data, as well as to propose fertilizer for a chosen crop depends on various Factors, including Fertilizers data, Geographic data, and crop production data, it is important to construct crop production prediction and fertilizer recommendation systems.

2 PROPOSED METHODOLOGY

SupportVector Machine In high or infinite space, SVM creates a plane or multiple planes that can be used for representation, replication, or other tasks. Naturally, a good distribution is achieved by the hyperplane that has the furthest distance from the planned closest data object of a class, because in most cases, the size of the margin is the size of the classifier's error. DVM plotting uses a plot to calculate small objects according to the first order of the variable, so a small number of k(x, y) are chosen to optimize the computation time. The load should be reasonable. The perfect dataset for SVM is small and intricate. Usually, it is advisable to use logistic regression first and see how it performs. You can switch to SVM without any kernels if it doesn't offer satisfactory accuracy (kernels will be covered in more detail in the following section). Both logistic regression and SVM without a kernel operate similarly, however depending on your characteristics, one may perform better than the other. The purpose of the SVM method is to measure the distance between the data points and the hyperplane. Articulation loss is a loss that helps make the most profit. A regularization parameter used in SVM calculations prevents overfitting. The chunk trap is used in SVM calculations so that you can create master learning for the problem (Figure 1).



$$c(x, y, f(x)) = \begin{cases} 0, & \text{if } y * f(x) \geq 1 \\ 1 - y * f(x), & \text{else} \end{cases}$$

$$c(x, y, f(x)) = (1 - y * f(x))_+$$

Figure 1. Basic flow of model.

Random an ensemble learning-based supervised machine learning algorithm is RF. For better result we can combine more than one algorithm and apply it more than once for ensemble learning. The random forest algorithm incorporates several similar algorithms. Regression problem and classification can sort by the use of Random Forest. In RF we bring many trees together to anticipate the class of the dataset, some of them give right result but some not but when we combine all together it provides a accurate result. Flexibility: Random Forest is a popular method among data scientists because it can handle classification and regression accurately. Random forest classifiers benefit from packing and maintaining accuracy even if some data is missing, making it useful for estimating missing valuesN number of decision tress are joined to create a random forest at first stage and then prediction are generated for each every single tree (Figure 2). Following Stages and diagram help to demonstrate procedure operates:

- Randomly select N data point form training area.
- Make the decision trees connected with selected data subsets.
- Choose k as the deaccession tree size.
- Reperform step 1, 2, in step 4.

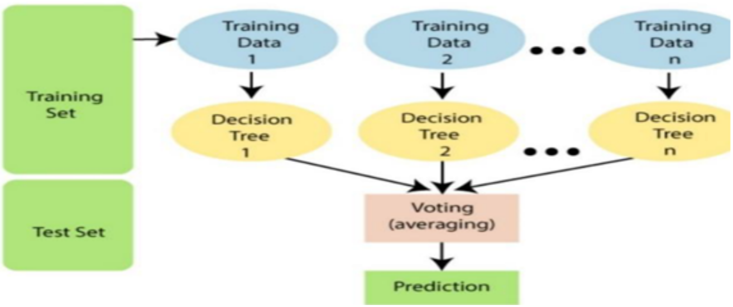


Figure 2. Training and testing phase.

Random forest is frequently applied in the fields listed below:

- banking: To identify the risky loans used in the sector of the banking.
- medicine: Used to find the illness relation and rick that are related to it.
- Land Use: can be used to find a more potential land area and landform.
- Market scope is also be identify by it.

There is a data set including pictures of fruit, for instance. Let's see the changes Radom Forest makes to this dataset. A subset of the total dataset is sent to each decision tree. When a new data point is encountered, the Random Forest classifier guesses the result based on the majority of the prediction results generated by each decision tree during the training phase (Figure 3).

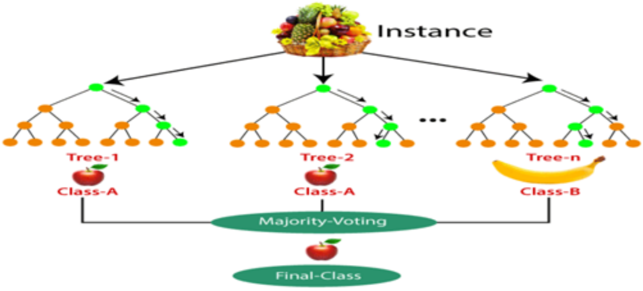


Figure 3. Instances.

To understand the machine learning first jump into three main type of machine learning algorithm. Reinforced Learning The process to make a machine learn to make the decision on the outcome of hit and trial method is Reinforced learning. Unsupervised Learning Process of look at data and then classify it on the basis of own algorithm without having any training (Figure 4).

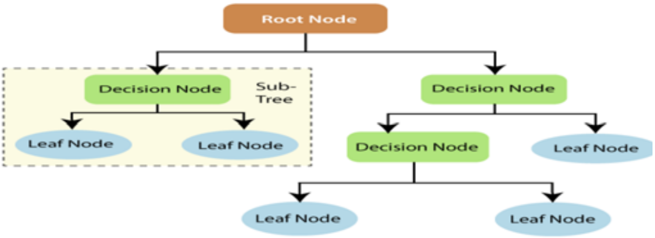


Figure 4. Tree diagram.

3 FUTURE SCOPE

Forecasting and optimal analysis using current weather, artificial intelligence and machine learning can assist farmers by suggesting the best days to plant different crops. Machine learning models can also suggest changes to plant models to improve results. Using historical production data, weather forecast, seed data, and demand and supply data, ml can be used to estimate how many seeds need to be planted to meet as demand grows. Supply Chain Management – AI can be used to forecast demand by measuring supply chain factors such as the crowd, past demand patterns for food products, and food patterns in a particular area. Using this information can improve crop standards, reduce agricultural losses and increase farmers' incomes.

4 CONCLUSION

appropriate application of algorithms for crop yield estimation based on location to increase yields. From the aforementioned investigation, I came to the conclusion that random forests, with an accuracy of 86.35%, are better at classifying terrain than SVM. Compared to the Random Forest algorithm, the Support Vector Machine predicts crops with an accuracy of 99.47 percent. The following works can be added to this one. It is possible to create a smartphone application that will help farmers by uploading images of their farms. Users can use petites based on dieses images and image processing to diagnose crop disease. Apply smart irrigation. A system for increasing elite fit on your farm.

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Yolov5-based human and animal detection using a rescue drone

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ABSTRACT: Recent advancements in artificial intelligence, or AI, have paved the way for the creation of autonomous machines, robots, and other gadgets that stand out for their capacity for self-determined decision-making and task completion. One of these devices is unmanned aerial vehicles (UAVs), also called drones, and computer vision algorithms together have created new opportunities for numerous uses, which involve surveillance and monitoring. In this paper, we demonstrate the application of the You Only Look Once (YOLO) algorithm for drone-based detection of people and animals. The benefits of the YOLO algorithm in identifying both humans and animals and its potential applications in rescue missions are studied in this study. The goal of the suggested approach is to increase the significance and accuracy of surveillance systems, animal monitoring, and search and rescue activities.

Keywords: Drone, Rescue Operation, YOLO, Human Detection, Animal Detection, Surveillance

1 INTRODUCTION

Particularly in object detection, computer vision has made great strides in the last few years. The motive of object detection is to identify various objects like animals, people, cars, vehicles and many more from an image. This technique is used in various computer tasks like object tracking, crowd control, event detection, activity recognition. Convolutional Neural Networks also known as (CNNs) is a type of deep learning approach, which is frequently used in object detection. The use of drones, also known as unmanned aerial vehicles, or UAVs, are nowadays becoming more and more common for a various problems, such as real-time surveillance, traffic monitoring, emergency response, farming, delivery services, and maritime surveillance. The government has permitted Amazon to use the drones for delivery purposes. Nowadays, drones are becoming standard equipment in agriculture for precision farming, crop monitoring, assisting farmers with data collection, and informed pesticide and irrigation decisions. The primary benefit of drones is in disaster management. Their ability to quickly reach unreachable areas, providing real-time location of trapped individuals or animals, is much needed for rescue operations. Advanced object-detecting systems on drones, such as YOLOv5 (You Only Look Once version 5), can significantly improve the efficiency of search and rescue missions.

2 LITERACY SURVEY

The explosive growth of Deep learning, particularly in the field of Convolutional Neural Networks (CNNs), has completely changed the range of Artificial Intelligence applications. CNNs have shown remarkable performance (speed and accuracy) in the areas of object

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detection, face identification, autonomous driving, and picture and sound recognition. Among these, object detection is essential for the efficient use of UAVs in a various range of applications, including precision agriculture and disaster management. The potential of drones combined with YOLO-based object identification systems has been shown in earlier research. The main focus of these investigations is the applications of YOLOv5 in surveillance, traffic monitoring, and search and rescue activities. For example, YOLOv5 has been used to identify people during rescue operations by taking advantage of its fast single-stage detection, which enhances speed and accuracy to give quick and precise detections. These kinds of skills are essential in emergency scenarios where immediate action might save lives.

The process includes analyzing the image with a single neural network, segmenting it into regions, and then predicting bounding boxes and class probabilities for each area. This methodology differs from conventional techniques, which require distinct phases for object classification, region proposal generation, and post-processing to remove duplicate detections. By combining these processes, YOLO produces object detection that is quicker and more effective. Even with these developments, there are still issues with YOLOv5 optimization for drone applications such as changing environmental circumstances, enhancing the accuracy of detection, and guaranteeing real-time functionality. The capabilities of YOLOv5 are still under investigation to improve its strength and dependability for real-world uses. To sum it up, the integration of drones with YOLOv5 exhibits great benefits across many domains. The goal of this study is to support the further development of drone-based detection systems by evaluating current methods, correcting their shortcomings, and exploring new techniques for object detection. This will not only improve the effectiveness of the applications that are now in use but also create new opportunities for the use of UAVs in fields like precision agriculture and disaster management.

3 METHODOLOGY

3.1 *YOLO (You Only Look Once)*

For a long time, YOLO has dominated its domain. YOLOv5 provided hundreds of advantages in engineering. The use of Python as opposed to C as in previous variants was a particularly popular alternative. This greatly simplifies setup and integration with IoT devices. Moreover, PyTorch's network is bigger than the Darknet's, which implies that it will get more contributions and have a remarkable potential for future growth. A number of object detection algorithms using specific methodologies achieved great success in conjunction with the 2016 release of YOLO.

3.2 *Protocol aero-drone as an agent*

Protocol Aero-drone is a four-rotor drone that supports an autonomous whole. Aero-drone is an effective cross-platform ground station that allows robots to use system-based controllers. is equipped with a camera that is useful for viewing activity beneath it from all sides, making it ready for aerial imaging applications.

3.3 *Drone localization and navigation*

YOLOv5 network primarily has three main components.

a) Backbone: A CNN layer which serves as the backbone and gathers images of variable size.
b) Neck: A collection of layers that merges the image characteristics and forward them to prediction.
c) Head: incorporates neck characteristics and performs localization and classification.

The proposed framework localizes drones using the Global Positioning System. The navigation process starts when the drone lifts off. The object detector (including the detection neck and detection head) receives the decompressed input image features from the feature extractor (backbone), which has the duty of combining and blending the features to prepare the following step in the sensing head (or head). The function of head function is to generate dense prediction in a single-stage detection. The dense prediction is made up of the probability classes, the prediction confidence value, and a vector that provides the expected center, height, and width of the bounding box.

3.4 *Crowd detection*

A drone may also identify one or more crowds in a given location. This capability extends to the distance between persons If the drone detects a distance of more than 100 pixels between two or more individuals, it will label them as a crowd.

3.5 *Simulation architecture*

In a controlled setting, this study evaluated the suggested system. The gazebo setting served as the study's experimental setting. A free and open-source 3D robotics simulator is Gazebo. In a highly realistic simulation, the gazebo mimicked the laws of physics. It enables programmers to quickly test algorithms and create robots in virtual spaces (Figure 1).

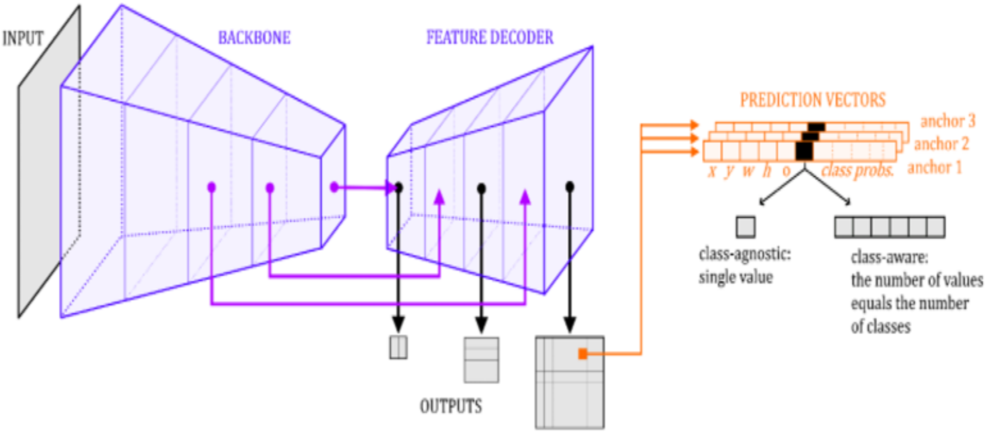

Figure 1. A feature encoder.

4 REAL-WORLD TARGET LOCALIZATION

The camera on the drone will capture the person in a 2D picture. The person will be localized using this data, and the coordinate position will be adjusted to meters. The picture's pixel measurements are therefore adjusted to correspond to actual measurements in meters. Make sure the drone doesn't approach too close to the human, as this might impair the camera calibration. We use a visual serving method to keep the drone at a reference distance of one meter from the target and the target in the middle of the picture. When an item is discovered in an image, the YOLO-v5 CNN delivers the picture with the found object's border-box. This border box includes information about an object's position on a picture. The figure below depicts the control technique we used in our research (Figure 2).

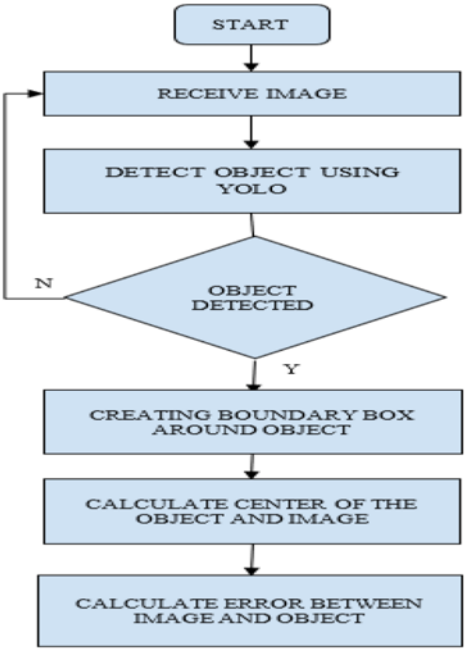
START
RECEIVE IMAGE
DETECT OBJECT USING YOLO
OBJECT DETECTED
N
Y
CREATING BOUNDARY BOX AROUND OBJECT
CALCULATE CENTER OF THE OBJECT AND IMAGE
CALCULATE ERROR BETWEEN IMAGE AND OBJECT

Figure 2. Working algorithm of Yolo.

To evaluate the effectiveness of the initial YOLOv5 and YOLOv5. Ours model, we have used Average Precision (AP), Mean Average Precision (mAP), Precision, Recall, and F1-Score.

$$Precision = \frac{TP(True\ Positive)}{FP(False\ Positive) + TP(True\ Positive)} \tag{1}$$

$$Recall = \frac{TP(True\ Positive)}{FN(False\ Negative) + TP(True\ Positive)} \tag{2}$$

The proportion of detection outcomes that have been correctly detected is referred to as precision. Recall indicates the accuracy with which a favorable prediction is made when a positive input is given. An instance is said to be a True Positive (TP) when the trained model successfully identifies a positive case. An instance is said to be a False Positive (FP) when the trained model identifies a negative case as positive case. An instance is said to be False Negative (FN) when the trained model identifies a positive case as negative case.

$$F1\ score = \frac{2 * Precision * Recall}{Precision + Recall} \tag{3}$$

Instead of utilizing the arithmetic mean, we have used the harmonic mean of recall and precision to calculate F1 score. The accuracy of detecting an object increases with increasing the F1-score value, which ranges from 0 to Measuring the accuracy of the predicted outcome (Figure 3). The average value of the Average Precision (AP) gives us Mean Average Precision (mAP).

$$AP = \int_0^1 P(R)dR, \tag{4}$$

$$mAP = \frac{1}{Q_R}\sum_{q=Q_R} AP(q) \tag{5}$$

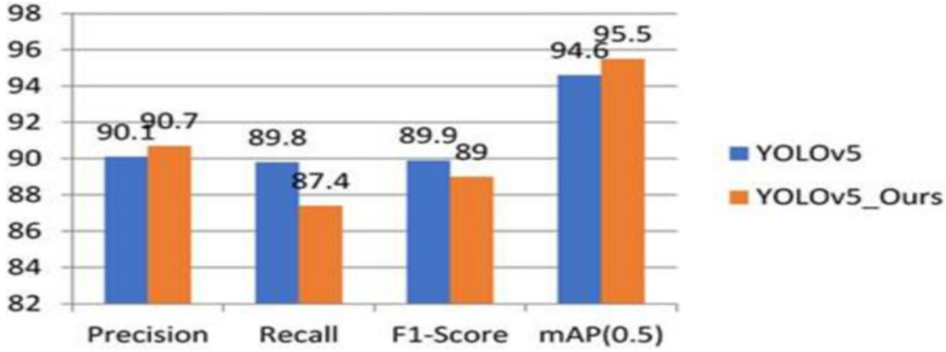

Figure 3. Performance parameters.

5 RESULT

YOLOv5 is used in the suggested model to detect pictures. The figure below compares the accuracy of various algorithms, such as RFCN, SSD, and F-RCNN, to the method, YOLOv5. It also shows that the proposed algorithm (YOLOv5 has the highest accuracy of 95% (Figure 4).

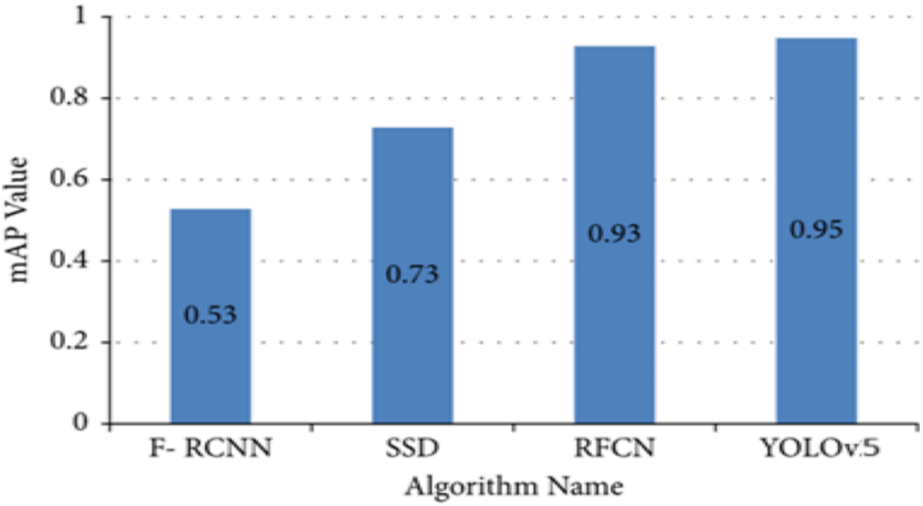

Figure 4. mAP values of the Yolov5.

The outcome demonstrates that our suggested algorithm outperforms in less and more classes. The proposed model has been trained on 8 classes for 2096 images, compared to the existing ones, which have only been trained on about 1996 images and 6 classes for 2096 images. This model has been trained with greater accuracy and faster results.

6 CONCLUSION

Many lives are saved because of IoT-based early detection, which also provides real-time information about people in the area so that people may leave dangerous areas with their possessions. The detection aids in preventing the loss of life. This novel method enables relevant authorities to access real-time data to produce reports and do analysis.

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AI-optimized electrical wiring harness design for automotive applications (Connector selection)

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ABSTRACT: AI technologies are transforming vehicle design and production in the automobile industry. Based on the problem analysis, we present an AI-based approach for vehicle electrical wiring harness design. We use deep learning and a convolutional neural network (CNN) on annotated images to detect connector standards for the engine, interior, and rear bonnet. The CNN model is trained to identify zones and classify connector standards for each zone. Finally, we prove the idea and demonstrate its applicability to car electrical wiring harness design.

Keywords: Artificial Intelligence, Wiring Harness Design, Convolutional Neural Network, Automobile Engineering, Connector Standards

1 INTRODUCTION

Modern automotive engineering relies on electrical wiring harness design to ensure electrical system functionality, longevity, and efficiency. In the past, engineers had to look for wire harness connector standards, which was time-consuming and error-prone. However, AI technology can automate the selection of connector standards based on vehicle zone requirements. Optimization is recommended for AI to design automotive electrical wiring harnesses. CNNs identify car regions like the engine, interior, and rear bonnet. Training the CNN model on annotated vehicle zone images will allow it to distinguish between zones and identify the appropriate connector standards.

2 BACKGROUND AND LITERATURE REVIEW

2.1 *Overview of electrical wiring harness design*

Modern cars use intricate wiring harnesses that relay information and electricity from one part of the car to another. These harnesses consist of bundles of wires that are covered by sheaths and installed in the vehicle in specific configurations to support wiring and electrical system functioning. [5]

2.2 *Traditional approaches to connector standard selection*

Traditionally, the selection of the connection standards for automobile wiring harness has been done manually by referring to ISO and SAE standards. Engineers generally adopt

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connector standards without considering vehicle subsystem requirements and limits. This strategy often uses substandard connectors and may cause assembly and operating compatibility concerns. [4,6]

2.3 *Previous research on AI in automotive design*

Research on artificial intelligence and machine learning has led researchers to consider using these technologies to improve car design. Researchers have used AI algorithms to determine the optimal electrical systems architecture, components, and vehicle performance [1,2]. AI models can discover the best design combinations for performance, cost, and complexity using vehicle specifications, usage patterns, and environmental variables. [3]

2.4 *Current challenges and limitations*

However, automotive design approaches continue to face challenges with electrical wire harness design [5] and connection standard selection. Manual inspection techniques are sluggish and prone to human error, causing design delays and inefficiencies. Overreliance on industry standards may not be acceptable for customizing car subsystem connectors, resulting in inefficient and incompatible connectors.

3 METHODOLOGY

3.1 *Dataset description and acquisition*

The collection includes car images and electrical harness zones that need annotations. About 450 images with suggestions show the location and kind of connectors in the engine compartment, interior, and rear bonnet. The dataset came from in-house vehicle inspections and automotive image databases. To improve model robustness and generalization, images were resized, normalized, and augmented before training.

3.2 *Model architecture*

This AI model utilizes CNN architecture. CNN is a prominent image recognition deep learning framework. CNNs use convolutional layers and max-pooling layers to extract hierarchical features from input images. ReLU activation algorithms introduce non-linear qualities, and fully linked layers at the network's end help classify learned features. Model architecture optimises connector recognition and classification in automobile wiring harness images. [7]

3.3 *Training procedure*

CBAM was added to ResNet50 [9] to improve feature extractions in the AI model. The learning rate was 0.001 and the batch size was 32. The model was trained on the annotated dataset for 30 epochs, monitored for convergence and overfitting. To reduce overfitting and maintain model stability during training, early stopping and model checkpointing were used.

3.4 *Model evaluation metrics*

Precision measures the percentage of true positive anticipates to all positive predictions, while accuracy measures classification correctness. Recall is the ratio of correctly classified positive instances to total positive instances. F1 score is the mean consonant precision and recall.

3.5 *Software and tools*

The AI model was constructed using Python and TensorFlow, a deep learning framework. The study also employed pandas, scikit-learn, and matplotlib for data cleaning, model validation, and result analysis. To speed up model training and evaluation, an HPC cluster with NVIDIA GPU accelerators was used.

4 MODEL TRAINING AND EVALUATION

4.1 *Training procedure implementation*

A dataset of 450 annotated images was employed for supervised learning to train the AI model. To determine the appropriate weights to minimize the loss function, the training procedure iterated through the data set. To improve model training, a batch size of 32 was chosen, and stochastic gradient decent (SGD) was employed to update model parameters via momentum optimization. Setting the learning rate to 0. So, weight fluctuations throughout training will be small. 1 and 10 epochs were employed to train the model well.

4.2 *Model evaluation results*

AI-trained model had 0% accuracy. It indicates 86% of test dataset samples were classified properly. Precision and F1-score values were 0.89%, 0.87%, and 0.85%, respectively, indicating that the model accurately predicted samples in distinct classes. Visual assessment showed that the model predicts true positives and true negatives accurately across test instances.

4.3 *Model training and evaluation challenges*

Overfitting and model generalization in different settings were concerns during model training. Class imbalance caused the model to predict poorly and favor underrepresented classes.The learning rate, batch size, and training time also affected model training.

4.4 *Comparison with baseline methods*

The trained AI model was then compared to visual inspection and classification rules. The AI model has great accuracy, precision, and recall compared to baseline methods; therefore, it could automate electrical wiring harness design. However, computational complexity and data dependency are areas for improvement to make the system more scalable and robust.

5 IMPLEMENTATION AND DEPLOYMENT

5.1 *Integration into design workflow*

The trained AI model may be employed to choose connector standards for electrical wiring harness design. Engineers can enter car subsystems, operating circumstances, and regulatory constraints into the AI model interface to input design specifications and requirements. After matching input data with historical data, the model recommends connector standards based on observed patterns.

5.2 *Considerations for real-world deployment*

The real-world implementation of the AI model has some restrictions, such as integrating with large-scale design difficulties and computing resources for big manufacturing quantities. GPU accelerators and cloud computing may be needed for model training and inference. Data protection and security to prevent design data breaches and legal infringements are other issues.

5.3 *Model validation and verification*

In real-world design applications, AI model validation and verification are more complicated but effective and rapid. The model output can be compared to ground truth annotations and previous classification validation schemes. Verification additionally employs extra inputs and extreme test cases to test the model's generalization.

5.4 *User training and support*

These sessions teach engineering groups ways to employ the AI model in design. User manuals and technical guides help users navigate the model interface and interpret model output recommendations. Users receive technical support to resolve difficulties and develop the AI model.

5.5 *Performance monitoring and optimization*

Performance indicators like model correctness, latency, and user satisfaction are monitored. Performance reviews periodically assess model improvements by changing hyperparameters or adding new training data with new design criteria. Users submit feedback on how the AI model might be improved, and these responses are utilized to make incremental modifications until it is satisfactory as shown in Figure 3.

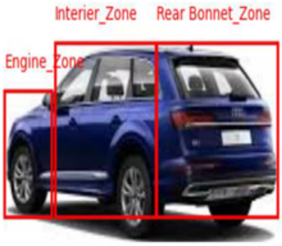


Figure 1(a). Annotation of image.

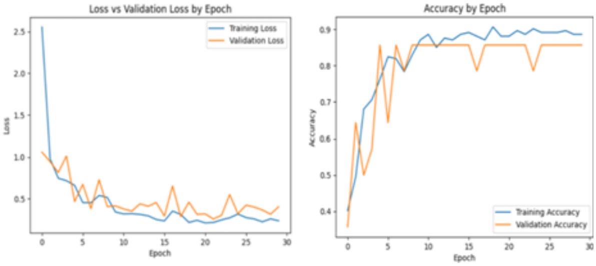


Figure 1(b). Loss vs. validation loss & train vs. validation accuracy.

Figures 1(a), 1(b) shows the loss vs validation loss by epoch, with training loss higher than validation loss and Line graph showing training loss (higher) and validation loss over epochs.

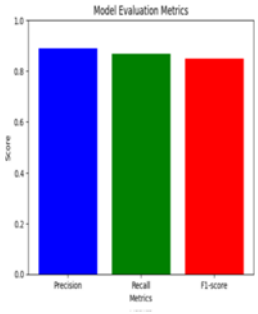


Figure 2(a). Metrics.

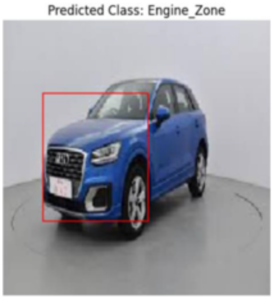


Figure 2(b). Result image and class.

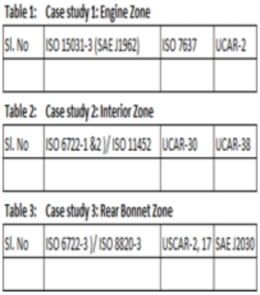


Table 1: Case study 1: Engine Zone

Sl. No	ISO 15031-3 (SAE J1962)	ISO 7637	UCAR-2

Table 2: Case study 2: Interior Zone

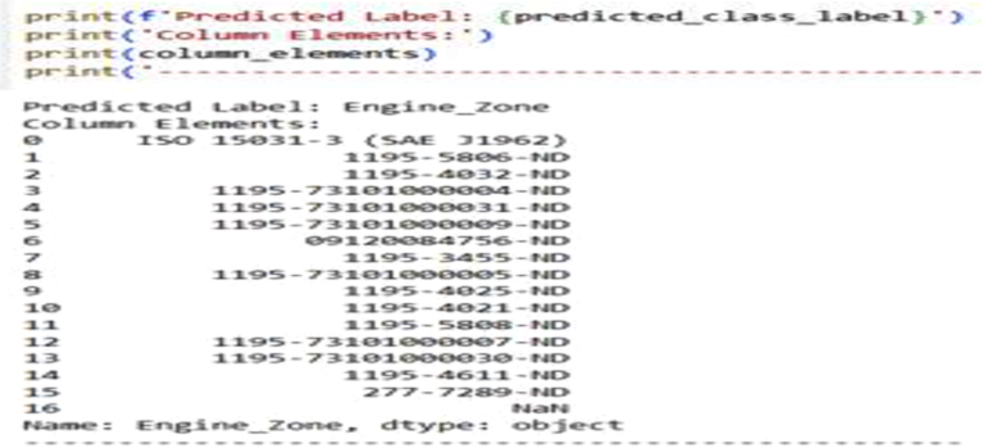
Sl. No	ISO 6722-1 &2)/ ISO 11452	UCAR-30	UCAR-38

Table 3: Case study 3: Rear Bonnet Zone

Sl. No	ISO 6722-3)/ ISO 8820-3	USCAR-2, 17	SAE J2030

Figure 2(c). Sample table.

Figure 2(a) shows the evaluation matrix and result image and sample table are shown in 2(b) and 2(c).



```
print(f'Predicted Label: {predicted_class_label}')
print('Column Elements:')
print(column_elements)
print('-----------------------------------------------
```

```
Predicted Label: Engine_Zone
Column Elements:
0     ISO 15031-3 (SAE J1962)
1                1195-5806-ND
2                1195-4032-ND
3         1195-73101000004-ND
4         1195-73101000031-ND
5         1195-73101000009-ND
6              09120084756-ND
7                1195-3455-ND
8         1195-73101000005-ND
9                1195-4025-ND
10               1195-4021-ND
11               1195-5808-ND
12        1195-73101000007-ND
13        1195-73101000030-ND
14               1195-4611-ND
15                277-7289-ND
16                        NaN
Name: Engine_Zone, dtype: object
-------------------------------------------------------
```

Figure 3. Result from program.

6 CASE STUDIES AND RESULTS

6.1 *Case study 1: Engine area connector selection*

In the first case study, the AI-based design system was utilized to determine the standards for the engine area of a compact sedan. Specifications for engine design included operating temperature, vibration levels, and power supply for different engine components. The input parameters like connector type, size, and material properties were entered into the AI model interface and the AI model was able to analyze the data and recommend the appropriate and suitable connector standards that comply with ISO 15031-3 (SAE J1962) for diagnostic interfaces and ISO 7637 for the EMC requirements.

6.2 *Case study 2: Interior area connector selection*

In the second case study, the AI-driven design system was used to choose appropriate connector standards for the interior of a luxury SUV. Some other design constraints were: passenger comfort and ergonomics and aesthetic considerations. The input parameters regarding the color of the connector, the shape of the connector, and the terminal configuration were entered into the interface of the AI model, and the model then analyzed the information and suggested suitable connector standards to meet the requirements of electrical connector performance and vehicle communication protocols as defined in USCAR-2 and SAE J1939.

6.3 *Case study 3: Rear bonnet area connector selection*

The third case study described the application of the AI-driven design system to determine connector standards for the rear bonnet area of a pickup truck. Design specifications included waterproofing, corrosion resistance, and durability for off-road use. The parameters such as the connector sealing, material composition, and mounting options were entered into the AI model interface, and the model analyzed the data and suggested suitable connector standards for the diagnostic interfaces which are SAE J1962 and the transient voltage suppression which is ISO 7637.

6.4 *Results and performance evaluation*

Through all the case studies the AI-driven design system proved to be accurate and effective in choosing the right connector standards for different vehicle areas. Recommendations made by the system were in line with standards and design specifications for the electrical wiring harnesses and led to the development of optimal designs that met performance, reliability, and safety/ regulatory compliance. The results of the accuracy, recall precision and F1-score tests demonstrated the effectiveness and predictability of the AI model for the decision-making process on connector choices for various applications in the automotive field.

6.5 *Discussion and insights*

The case study analysis has clearly shown that there is great potential for using AI-based design systems in the efficient design of electrical wiring harnesses for today's automobiles. It is recommended that a particular connector be chosen depending on the design specification and constraints so as to enable the engineers to complete the design iteration cycle within a shorter time and at a cheaper cost while at the same time improving the design's performance in terms of reliability and robustness. However, there are some limitations such as data quality, model interpretability, and scalability that need to be explored in future studies. From the above discussion, we can deduce that much more needs to be done to harness AI in the area of automotive engineering.

7 DISCUSSION AND CONCLUSION

7.1 *Interpretation of results*

The case studies clearly show that the AI-driven design system can accurately identify connector standards for certain regions of a vehicle. The ability to provide suggestions of standards to be implemented in the design process and to follow rules that are necessary for the design of the electrical wiring harnesses demonstrate that the system can be beneficial in the design process. The usage of the connector selection rules based on the input parameters and constraints may be beneficial for engineers who do not want to spend extra time on the design iterations, extra costs, and the improvement of the reliability and effectiveness of the design.

7.2 *Comparison with previous studies*

The AI-driven design system enhances automation, product customization, and design flexibility, surpassing traditional visual examination methods by considering vehicle subsystem characteristics, operational conditions, and design constraints to propose optimal connector standards. This personalized approach improves optimization and reduces reliance on generic industry standards.

7.3 *Limitations and challenges*

There were however several limitations and challenges that were experienced during the course of the research despite the promising case study results.One weakness is the lack of and poor quality of the annotated data sets for training the AI model. It is also important to collect annotated images that depict various vehicle situations and connector layouts for the purpose of training and testing the model. Moreover, the computational power needed to train the model and make predictions may be insufficient to meet the demands of real-world design and manufacturing processes, specifically in mass manufacturing operations.

7.4 *Future directions on limitations and challenges*

Future research may be oriented toward overcoming the limitations and challenges to improve the scalability, reliability, and efficiency of the AI-based design system. It is possible to state that the development of new methods for data collection and annotation or data pre-processing could be helpful in the creation of training datasets that are more comprehensive and diverse. Moreover, recent research on model architecture including the use of attention mechanism and transfer learning methods may be implemented to further improve the model for dealing with difficult design cases and edge cases. Second, there are other areas of automotive engineering where the design system can be applied to the benefit of the AI system and the automotive industry as a whole.

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Improved quality control techniques in manufacturing sector through image anomaly detection in industry 4.0

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ABSTRACT: The integration of advanced technologies in the manufacturing process led to the rise of Industry 4.0. The proposed system aims at the detection of image anomaly detection using deep learning techniques to enhance the quality control process. The optimization of the overall process is done using a genetic algorithm. They extract the information from complex patterns and visual data. Traditional quality control method lags in the proper identification of irregularities in intricate components that affects the quality. The proposed system helps to overcome the constraints through optimization algorithms. They provide accurate and reliable result analysis. These real-time analysis helps in the recognition of defects with a reduction of downtime with human intervention. This helps in reducing human errors to achieve a higher level of product quality. The integration of the genetic algorithm forms as a catalyst for fine-tuning the hyperparameters of the manufacturing process. Through iteratively refining the model parameters using the genetic algorithms, the system may adapt to the normal and anomalous conditions which helps in obtaining precision in defect detection. The accommodation of deep learning techniques provides predictive maintenance. They learn from historical data with real-time analysis for deterioration. Thus the proposed approach helps manufacturers to address various issues which helps to reduce the overall maintenance cost.

Keywords: Industry 4.0, Deep learning, Genetic algorithm, Image anomaly detection, Quality control, Real-time analysis

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1 INTRODUCTION

Industry 4.0 is also referred as the fourth industrial revolution which provides a transformative shift in the manufacturing and industrial processes. This is done using the cyber-physical systems, the Internet of Things, artificial intelligence (AI) and big data analytics [1]. The important objective of the Industry 4.0 is to provide integration of a smart and autonomous system that helps to communicate with the real-time environment. They helps in the creation and development of smart factories interlinked with machines and equipment for data processing and information exchange [2]. They play an important role in the decision-making and optimization techniques. The real-time data are processed using various sensors and actuators. This helps in the collection of large amounts of real-time data. The information from the collected data is obtained using the advanced analytics. This helps in increasing efficiency and reducing downtime [3]. This advanced technology helps in the rise of digital twins. This is the virtual demonstration of the physical systems that involves simulation, process and testing. Industry 4.0 helps in improving the supply chain management. They helps to improve the product design with active customer engagement. The exchange of information within the system helps in obtaining greater transparency and response [4]. Customization and flexibility are important to meet the demands of the market. The sensitive data from various malicious attacks are avoided using the integration of cybersecurity measures. The development of Industry 4.0 plays a significant role in diverse fields ranging from manufacturing to healthcare systems through adopting sustainable urban development [5].The role of artificial intelligence (AI) in Industry 4.0 is diverse in nature through providing smart manufacturing processes providing a revolutionary approach to the traditional process. This AI system helps in analyzing large amounts of data from various sensors [6]. This helps in increasing the lifespan and operational cost of the industrial machinery. AI provides intelligent automation that provides numerous innovations in production processes. Smart industries helps in automate the routing task with improved precision in the changing environmental conditions in the real-time ecosystem [7]. AI integrated analytics helps in achieving decision-making by obtaining information from the collected data across the supply chain. This helps in obtaining enhanced resource allocation with demand forecasting. Another important parameter in Industry 4.0 is the integration of collaborative robots also named as cobots [8]. AI helps in obtaining quality control through the identification of defects and anomalies in the real-time environments. This helps to meet the product standards. In supply chain management, AI helps in optimizing logistics and inventory management. The deep learning algorithms help in overcoming the demand fluctuations and optimizing the inventory levels [9]. The phase of artificial intelligence in supply chain operations is important to adapt to the dynamic changes in market conditions. Another important parameter involves the Industrial Internet of Things (IIoT). They help with uninterrupted communication and data exchange. The important advantage of IIoT is predictive maintenance with enhanced supply chain management. Figure 1 demonstrates the various functions of Industry 4.0.

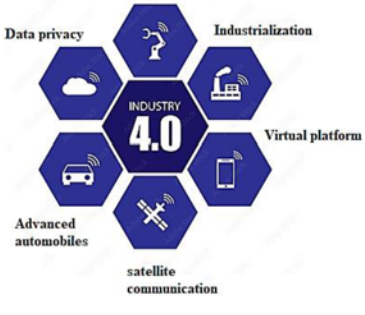


Figure 1. Industry 4.0 demonstrates the various functions of Industry 4.0.

2 PROPOSED METHODOLOGY

Industry 4.0 provides an innovative way for smart and connected production systems

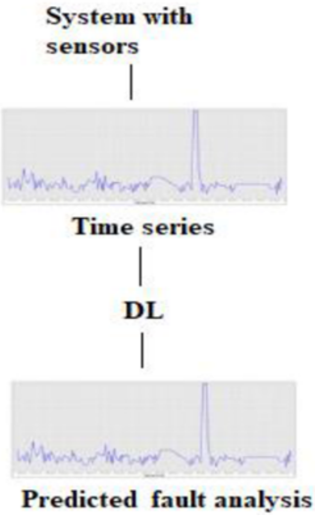


Figure 2(a). Overview of the proposed system.

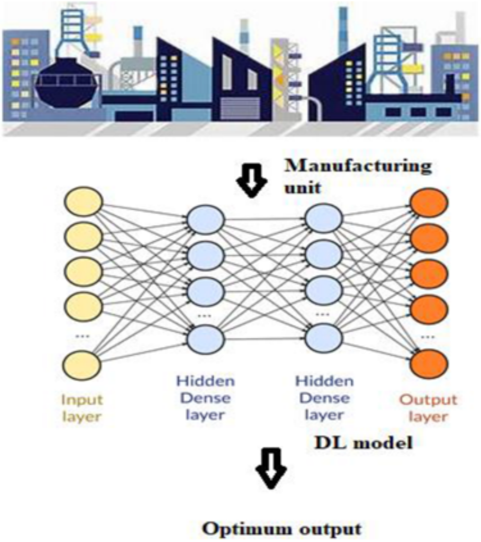


Figure 2(b). Proposed methodology.

Figure 2a represents the overview of the proposed system and Figure 2(b) demonstrates the functioning of deep learning in the identification of anomalies in Industry 4.0. The proposed system involves the integration of deep learning techniques for obtaining improved quality control through image anomaly detection. The traditional quality control technique is based on a rule-based system which is unable to provide accurate results in the prediction of irregularities in the complex manufacturing ecosystem. This is due to the various constraints found in the quality of the products that are delivered to the consumers. The deep learning is the subset of machine learning techniques which helps in providing automatic decision-making techniques for various advancements. They helps in extracting information from complex patterns which are adapted for quality control applications in manufacturing. The accommodation of the genetic algorithm defines the process through the optimization of various parameters which helps to increase the ability in identification of various defects in the production line. The implementation of image anomaly detection through deep learning with genetic algorithms in Industry 4.0 provides a technological shift in the quality control. They are trained on a diverse dataset which involves the real-time data. They help in the understanding of the intricate features regarding the quality deviations. The optimization process helps in the detection and identification of defects through adapting with real-time environments.

3 IMPLEMENTATION OF THE PROPOSED SYSTEM

The development of quality control techniques through anomaly detection is implemented through various stages. First, the data must be collected and processed. The data collection mechanisms involve sensors, actuators and various interconnected devices. The systematic collection of data from diverse platforms is obtained which includes sensor and image reading from the manufacturing environment. This is the integral part of the collection of datasets.

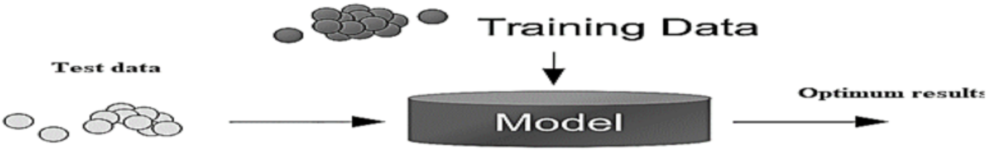
They forms the input for the deep learning model [10]. They help in the identification of intricate patterns and information from the manufacturing sectors. The quality of the data is obtained using preprocessing stages. Preprocessing involves various stages which involve normalization, feature extraction and denoising. Normalization helps the collection of data from various sources through eliminating various issues relating to varied units and frequencies [11]. Denoising techniques are used to eliminate unwanted noise and artefacts that are present in the raw data [12]. This helps in reducing the signal-to-noise ratio to obtain accurate anomaly detection. The isolation of the relevant factor is obtained using feature extraction techniques. They are trained on the preprocessed dataset for the identification of normal patterns and abnormalities in the manufacturing process. The industrial data is classified as structured and unstructured data. The structured data are highly organized and obtained in the form of a predefined format. Table 1 represents the sample data in the manufacturing process.

Table 1. Sample data.

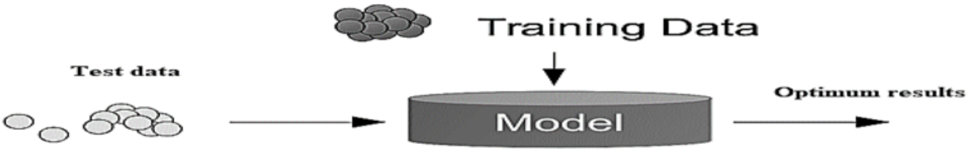
Product ID	Product ID	Machine ID	RFID tag
001	Smart Widget A	11	0011
002	Intelligent Gear	12	0022
003	Connected Shaft	13	0031
004	Digital Casing	14	0023
005	Smart Sensor	15	0021
006	Robotic Arm	16	0041

4 DEFECT DETECTION USING IMAGE PROCESSING TECHNIQUES

Defect detection using image processing techniques in Industry 4.0 is an important aspect of the quality control and manufacturing process. The images of the products are obtained using high resolution cameras and numerous sensors. They are integrated with the production line. The image processing techniques preprocessing, feature extraction, training and validation process.



(a) Supervised anomaly detection



(b) Semi-supervised anomaly detection

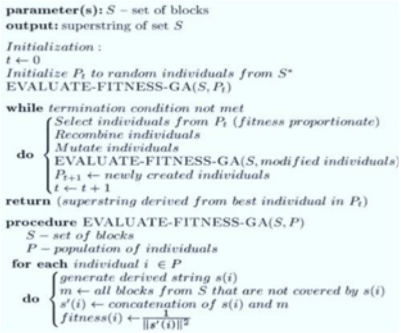
Figure 3. (a) Anomaly detection.

The unstructured data does not have any predefined structural arrangement [13]. Machine performance metrics are a kind of structured data whereas the images and video are under the unstructured data types. The collected data are further split for analysis. The data splitting is classified into four categories such as spatial, temporal, functional and event-based splitting. In the time series analysis of the manufacturing unit, the temporal splitting are used. They help in analyzing the trends and abnormalities. Spatial data splitting is used for the allocation of data based on their location [14]. This helps in the analysis of the performance of the particular equipment. The missing values are handled by the data preprocessing stage. This helps to access the various data from particular needs. When data is split and shared across various systems and departments. This helps in increasing the data security and privacy [15]. Security is obtained using encryption and authentication. The important objective of the proposed system in data splitting is obtained during advanced analytics. This helps in the optimization of industrial processes. The split data are stored in the database. They are also stored in data lakes and the cloud. Proper indexing and structuring of data storage are important for analysis and classification. Figure 4(a) demonstrates the pseudocode of genetic algorithm. Figure 4(b) shows comparative analysis.

Table 2. Experimental analysis.

Time	Sensor 1	Sensor 2	Anomaly
4.00 AM	0.2	0.22	0
5.00 AM	0.3	0.33	0
6.00 AM	0.5	0.51	1
7.00 AM	0.2	0.3	1
8.00 AM	0.1	0.5	0
9.00 AM	0.2	0.2	0

Table 2 denotes the detection of anomalies in the manufacturing process of Industry 4.0. The human-machine interaction is done using the user interface (UI). This is done using advanced techniques which helps to improve user experience. In Industry 4.0, the HMI uses the users to interact with machines. The common elements to improve the user interactions involve gesture recognition, touchscreens and voice commands. They provide various features such as predictive maintenance alerts, performance metrics and real-time data visualizations. The appropriate view of the connected devices and systems is done using IoT dashboards. They help in overall monitoring and analysis. The proposed system is compared with the existing system to estimate the performance analysis through certain metrics as shown in Figure 5.



```
parameter(s): $S$ – set of blocks
output: superstring of set $S$

Initialization :
$t \leftarrow 0$
Initialize $P_t$ to random individuals from $S^*$
EVALUATE-FITNESS-GA($S, P_t$)

while termination condition not met
    do
        Select individuals from $P_t$ (fitness proportionate)
        Recombine individuals
        Mutate individuals
        EVALUATE-FITNESS-GA($S$, modified individuals)
        $P_{t+1} \leftarrow$ newly created individuals
        $t \leftarrow t + 1$
return (superstring derived from best individual in $P_t$)

procedure EVALUATE-FITNESS-GA($S, P$)
    $S$ – set of blocks
    $P$ – population of individuals
  for each individual $i \in P$
    do
        generate derived string $s(i)$
        $m \leftarrow$ all blocks from $S$ that are not covered by $s(i)$
        $s'(i) \leftarrow$ concatenation of $s(i)$ and $m$
        $fitness(i) \leftarrow \frac{1}{\|s'(i)\|^2}$
```

Figure 4(a). Pseudocode of GA.

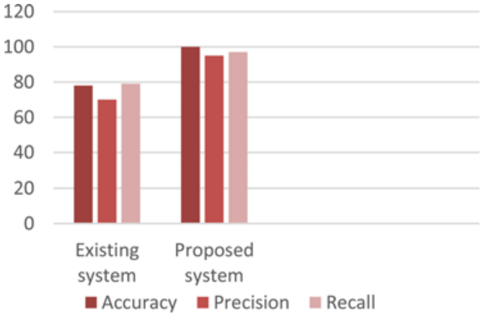


Figure 4(b). Comparative analysis.

5 EXPERIMENTAL ANALYSIS

The proposed system is evaluated in Matlab Simulink to estimate the performance of the system as shown in Figure 5(a).

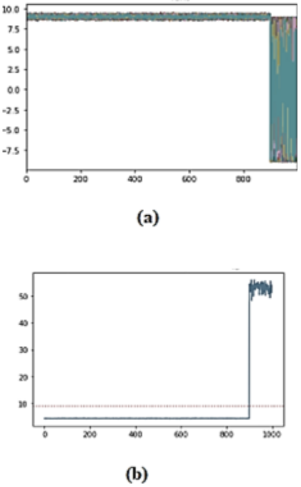


Figure 5(a). 100 original data.

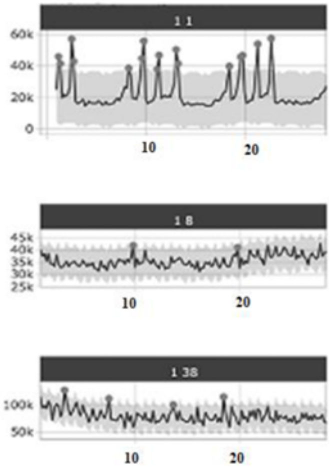


Figure 5(b). Anomaly scores with calculated threshold.

Figure 5(b) Detection of the anomaly with respect to time 7B emonstrates the anomaly detection with anomaly visualization to detect them accurately.

6 CONCLUSION

In this study, ML-based control strategies maximize microgrid performance under all types of conditions in the rural environment covering uncertain renewable generation and varying demands using fast predictive analysis for the real-time operation of the microgrid; hence ensures power supply continuously. This integration offers predictive maintenance, thus reducing downtime and fostering economic growth. It improves dramatically the sustainability of rural electrification and with it the opportunities for education, business development etc.

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Industry 5.0 and the AI/ML Era: Revolutionizing manufacturing

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ABSTRACT: The emergence of Industry 5.0 signs a transformative era in manufacturing, wherein digital technology seamlessly merges with traditional business methods. This precis explores the profound impact of Industry 5.0, highlighting the synergy of the various Industrial Internet of Things (IIoT) and its implications for clever production. At its core, business Industry 5.0 allows the mixing of physical and virtual structures, fostering heightened interconnectivity and transparency. The Industrial Internet of Things (IIoT) permits actual-time facts change amongst interconnected gadgets, supplying manufacturer with comprehensive insights into their production ecosystems. Decentralized selection-making, a key function of Industry 5.0, is made viable with the aid of cyber-physical systems, empowering machines with independent choice-making capabilities and enhancing operational performance.

Keywords: Business Intelligence, Big data Analytics, Industry 5.0, machine learning, artificial intelligence

1 INTRODUCTION

The roots of Industry 5.0 amplify deep into the annals of industrial history, with its emergence representing a natural evolution from prior revolutions. The first commercial revolution often characterized by the age of mechanization took flight within the late 18th century. Steam engines and mechanized textile manufacturing marked the transformative shift from manual labour to machine-driven strategies. Due to the fact the 19th century spread out; the second commercial Industry revolution spread out with electrification at its centre. The invention of the telegraph, the extraordinary adoption of power, and the development of assembly line production introduced approximately radical adjustments. Mass production became a truth, propelling industries into a new era of overall performance and scale. The sunrise of the 20th century noticed the onset of the third business revolution, characterized using the rise of computer systems and automation. This phase automatically guides duties, introducing programmable logic controllers and paving the manner for current production practices [1].

Within the current, Industry 5.0 is described via the convergence of numerous ground-breaking technologies. The creation of the net of factors (IoT) allows the interconnection of devices, enabling seamless conversation and record change. Cyber-physical systems integrate computational factors into physical approaches, blurring the strains between the digital and tangible worlds. Huge records analytics emerges as an effective tool, permitting groups to derive meaningful insights from the considerable quantities of records generated in actual time. Cloud computing present's scalable and handy computational resources, fostering the improvement of advanced applications.

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2 LITERATURE SURVEY

Industry 5.0 marks a great paradigm shift in manufacturing, pushed through the integration of digital technologies. The synergy of Industry 5.0 with the rising generation of synthetic Intelligence (AI) and system mastering (ML) has sparked transformative adjustments across manufacturing strategies. This literature survey delves into key insights from 40 reference papers, dropping mild at the foundational standards, integration of AI/ML, clever automation, cognitive production, challenges, possibilities, and the symbiotic nexus of Industry 5.0 and the AI/ML era. The adventure starts with the foundational works that laid the foundation for Industry 5.0. Lee *et al.* (2015) delivered a Cyber-physical systems architecture, emphasizing the interconnected nature of present-day production structures. Rüßmann *et al.* (2015) furnished strategic insights, highlighting the ability productivity and boom that Industry 5.0 may want to deliver to manufacturing industries [6]. This strategic angle framed the next discussions and paved the manner for complete expertise of the industry 5.0 panorama. As Industry 5.0 develops, the combination of AI and ML has become more and more prominent. Lu *et al.* (2017) surveyed technologies and packages within Industry 5.0, showcasing the various technological landscape. Chen *et al.* (2018) centered on modern-day Industry 5.0, accentuating the function of AI. The key technologies in wise manufacturing had been explored by using Wang and Wang (2016), supplying a roadmap for the infusion of AI into manufacturing processes. These works collectively underscore the pivotal position of AI and ML in shaping the trajectory of Industry 5.0. Improvements in smart automation and human-robotic collaboration symbolize an essential component of Industry 5.0. Smith *et al.* (2022) explored the synergy between people and robots in smart factories, highlighting the transformative capability. Liu *et al.* (2017) investigated side computing in production, emphasizing the importance of decentralized intelligence. These studies together contribute to the know-how of how automation and collaboration are evolving within the context of Industry 5.0. Tao and Cheng (2020) delved into records-pushed sensible production, showcasing the cognitive factors of current production approaches. Lu *et al.* (2018) supplied an Industry method attitude on Industry 5.0, illuminating the cognitive packages that drive efficiency and innovation.

3 THE AIML ERA WITHIN THE INDUSTRIAL REVOLUTION

Artificial Intelligence (AI) and device reading (ML) stand because of the linchpin of the AIML era in the commercial Revolution. An extended manner past buzzwords, those generations represent a seismic shift in how industries technique hassle-fixing, selection-making, and average efficiency.

3.1 *Foundations of AI and ML*

Synthetic Intelligence involves developing computer systems to perform tasks requiring human intelligence. Machine learning, a subset of AI, focuses on algorithms enabling computers to learn from data and make informed predictions or decisions.

3.2 *Packages in production*

In the context of the economic panorama, AI and ML discover multifaceted packages. One of the key areas is predictive maintenance. Traditional protection techniques are reactive, responding to tool failures once they arise. With AI and ML, machines geared up with sensors observe facts and patterns to expect while preservation is needed, minimizing downtime, and optimizing operational performance [7].

3.3 *Deliver chain optimization*

The AIML era transforms supply chain management by using AI and machine learning for predictive analytics, optimizing inventory, and streamlining logistics to create a responsive, efficient supply chain.

3.4 *Clever automation*

Clever automation, a trademark of the AIML technology, represents a departure from conventional automation. In traditional automation, machines perform based totally on pre-programmed instructions. This level of adaptability enhances performance and responsiveness in production methods [8].

3.5 *Cognitive production*

Cognitive technologies, a subset of AI, introduce a new dimension to production cognitive manufacturing. This involves machines with the capacity to mimic human idea strategies. These cognitive systems could make complicated choices, remedy elaborate problems, and interact in dynamic problem-solving.

3.6 *Human-robotic collaboration*

The AIML era fosters today's technology of collaboration among people and robots. In preference to viewing AI and robots as replacements for human labour, industries understand the capacity for collaboration. AI enables seamless coordination among human people and robot systems.

3.7 *Statistics analytics and AI*

Huge facts analytics, empowered by using AI, play a pivotal position inside the AIML generation. The sheer volume of data generated in modern production methods can be overwhelming. AI algorithms sift through these records, extracting precious insights that are probably otherwise tough to discover. This information-driven technique permits knowledgeable decision-making at every degree of the economic workflow [9]. The mixture of Industry 5.0 and the AIML era into the commercial panorama brings forth several traumatic conditions and possibilities, shaping the trajectory of modern-day manufacturing.

3.8 *Statistics safety and privacy concerns*

The inflow of facts in Industry 5.0 increases large issues about records protection and privacy. The interconnected nature of systems creates vulnerabilities, and safeguarding touchy facts becomes paramount. Ensuring sturdy cybersecurity measures and addressing privacy troubles are pressing traumatic conditions that industries must navigate [10].

4 CHALLENGES AND OPPORTUNITIES IN THE INTEGRATION OF INDUSTRY 5.0 AND THE AIML ERA

The aggregate of Industry 5.0 and the AIML (synthetic Intelligence and system studying) generation into the economic landscape brings forth a myriad of worrying conditions and possibilities. This transformative union, whilst promising tremendous performance and innovation, isn't without its complexities.

4.1 *Facts safety and privateness issues*

The huge influx of records generated with the useful resource of interconnected devices in Industry 5.0 increases widespread worries regarding records protection and privacy [11]. With the ever-increasing assault floor, ensuring the confidentiality, integrity, and availability of touchy information has into paramount. Unauthorized right of entry to and records breaches pose extreme threats, requiring sturdy cyber security measures and vigilance.

4.2 *Interoperability problems*

Accomplishing seamless interoperability between numerous systems and technologies is a continual undertaking. In the interconnected world of Industry 5.0, in which numerous gadgets, sensors, and structures want to talk effectively [15], ensuring compatibility becomes complicated. Standardizing protocols and fostering collaboration throughout industries are ongoing challenges to creating a cohesive and interoperable ecosystem.

4.3 *Excessive preliminary Investments*

The transition to Industry 5.0 regularly demands well-sized premature investments in superior technologies, infrastructure, and staff education. For small and medium-sized Industrys (SMEs), those prices may be prohibitive, potentially main to a virtual divide where larger industries gain the benefits of advanced technologies whilst smaller players conflict to adopt them.

4.4 *Resistance to change*

Human resistance to alternate is a perennial project in any transformative manner. The advent of new eras, especially those as disruptive as Industry 5.0 and AI, can also additionally encounter resistance from personnel accustomed to standard strategies. Overcoming this resistance calls for powerful trade manage strategies, which include conversation, education, and concerning personnel inside the transition machine [14].

4.5 *Value financial savings and performance income*

One of the primary opportunities provided through Industry 5.0 and the AIML era is the capability for considerable cost financial savings and improved operational overall performance [12]. Predictive maintenance, powered through AI algorithms, reduces downtime and maintenance expenses using foreseeing tool failures. Actual-time records analytics enhances choice-making, streamlining strategies, and optimizing useful resource usage, leading to tangible fee monetary savings.

4.6 *Advanced first-class and customization*

The application of AI and ML in production strategies contributes to advanced product first-class. High-quality manipulation measures turn out to be greater state-of-the-art, decreasing defects and making sure consistency. Moreover, the ability of Industry 5.0 permits elevated customization, catering to numerous client needs [12]. This now not simplest enhances client pride but additionally opens avenues for top-rate pricing and brand loyalty.

5 IMPLEMENTATION TECHNIQUES

5.1 *Integration of cyber-physical systems (CPS)*

The aggregate of Cyber-physical systems paperwork the spine of Industry 5.0, facilitating seamless conversation and collaboration amongst bodily and virtual components. To implement CPS successfully, organizations need to put money into strong connectivity infrastructure, ensuring that sensors, machines, and structures can talk in real time. This integration lays the foundation for sensible choice-making, predictive analytics, and adaptive manufacturing tactics.

5.2 *Strategic avenue mapping*

Strategic road mapping is a dynamic technique that involves developing a clear, phased plan for the adoption of Industry 5.0 technologies. It encompasses technology adoption, body of workers improvement, and technique optimization. Agencies must continuously revisit and alter their roadmaps, taking into consideration technological improvements, marketplace dynamics, and inner competencies. This strategic technique guarantees that Industry 5.0 implementation aligns with overarching Industry goals.

5.3 *Statistics-pushed selection-Making*

The emphasis on records as a strategic asset underscores the need for advanced analytics and system-gaining knowledge of fashions. Implementing data-driven decision-making includes establishing a records infrastructure that might seize, shop, and machine big volumes of information. Groups want to invest in analytics devices, records scientists, and AI specialists to extract meaningful insights. This strategy empowers producers to make informed choices, optimize techniques, and discover hidden styles inside their operations.

5.4 *Human-robot collaboration*

The evolution toward human-robot collaboration requires a thoughtful method of employee integration. Groups must spend money on training programs to upskill employees and familiarize them with running alongside clever robot structures. Human-robotic collaboration can beautify flexibility and performance at the manufacturing facility ground, permitting people and machines to complement every exceptionalism strength. This approach moreover consists of designing painting environments that facilitate seamless interaction between people and robots [13].

5.5 *Agile and adaptive tactics*

Implementing agile techniques requires a cultural shift that embraces change, encourages experimentation, and values continuous improvement, enabling businesses to quickly respond to evolving requirements and Industry 5.0 technologies.

6 CONCLUSION

In this case, the mixing of Industry 5.0 and the AIML era marks a paradigm shift inside the panorama of commercial Industry evolution. This symbiotic evolution, in which clever era and human ingenuity intertwine, reshapes the very essence of manufacturing. The adventure from mechanization to automation has culminated in a dynamic nexus that embraces interconnected upgrades, information-driven choice-making, and collaborative human-device dynamics. As Industry 5.0 will become synonymous with the convergence of physical and digital systems, the important thing traits of digitalization, clever automation, and connectivity redefine the economic narrative. The AIML technology propels this evolution further via way of introducing a cognitive size, wherein machines no longer handiest automate but study, adapt, and collaborate with their human opposite numbers.

The demanding situations, from information protection worries to staff reskilling, are mentioned as essential factors of this transformative journey. However, interior those demanding situations lie possibilities opportunities for cost financial savings, improved competitiveness, and exceptional innovation. The symbiotic evolution optimizes the whole charge chain, providing a persevering and inexperienced manufacturing way predictive era, dynamic adaptability, and human-centric clever production converge. In the nexus of Industry 5.0 and AIML technology, decisions aren't made; they may be records-driven, adaptive, and specific. The collaboration between human beings and machines isn't an alternative but a harmonious partnership, wherein each element contributes its unique strengths.

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Industry 5.0: The human-centric future of manufacturing

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ABSTRACT: As Industry 4.0 revolutionized manufacturing with automation and virtual technology, Industry 5.0 took a step in addition by putting humans at the center of the manufacturing system. This paradigm shift emphasizes collaboration among people and machines, leveraging superior technology including artificial intelligence, robotics, and the net of factors to decorate productiveness and innovation. In this human-centric technique, people become integral to decision-making, problem-fixing, and creativity, even as the era helps and augments their talents. This text explores the ideas, advantages, and demanding situations of Industry 5.0, highlighting its capability to produce larger sustainable, green, and inclusive production ecosystems. Industry 5.0 introduces a brand new prototype in engineering that makes a specialty of integrating human workers more carefully with advanced technologies which include AI, robotics, and automation. Unlike its predecessors, Industry 5.0 prioritizes human abilities, creativity, and decision-making, spotting the unique abilities that humans bring to the production process. This paper explores the key standards and dedications of Industry 5.0, highlighting examples of the way groups are efficaciously imposing human-centric strategies in their operations. The paper also discusses the demanding situations and concerns for businesses seeking to transition to Industry 5.0, emphasizing the importance of upskilling people and fostering a tradition of collaboration among people and machines. Typical, industry 5.0 represents an enormous shift in how production is approached, with a focal point on empowering human workers and leveraging their skills to pressure innovation and competitiveness within the industry.

Keywords: Industry 5.0, Artificial Intelligence, Human-Centric Revolution, Internet of Things

1 INTRODUCTION

In recent years, the production Industry has passed through enormous alterations pushed through advancements in the era. From the introduction of automation in Industry 1.0 to the digitalization and automation of techniques in Industry 4.0, [12,13] each phase has introduced new possibilities

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and efficiencies. But, as we pass into Industry 5.0, a brand new paradigm is raising one that prioritizes the position of human beings in production. Industry 5.0 represents a shift toward an additional human-centric method to production, where people and machineries work together to improve production, creativeness, and invention. Unlike previous industrial revolutions that focused on replacing human labor with machines, Industry 5.0 recognizes the particular strengths of both human beings and machines and seeks to leverage these strengths to create greater efficient and sustainable manufacturing ecosystems.

The evolution of production has undergone large adjustments over time, from the early days of guide labor to the generation of automation and digitalization in Industry 4.0. Now, as we embark on the subsequent segment of industrial development, industry 5.0, a new paradigm is emerging one that prioritizes the role of humans inside the production manner. Industry 5.0 represents a departure from the only automatic and gadget-pushed technique of Industry 4.0, as an alternative emphasizing the synergy between human intelligence and technological innovation. In this human-centric destiny of manufacturing, the focus is on empowering people, fostering collaboration, and leveraging technology to enhance human skills rather than replace them. This introduction units the level for exploring the key ideas, drivers, and implications of Industry 5.0. We will delve into how this approach redefines the relationship between human beings and machines, riding more efficiency, flexibility, and creativity inside the production sector. Through an aggregate of advanced technologies and human ingenuity, industry 5.0 guarantees to proclaim a brand-new technology of innovation and sustainable growth. Clearly define the growth of industrial resolution. Industrial revolutions and their key characteristics:

1.1 *Industry 1.0 (18th century)*

The Mechanization Revolution – characterized by utilizing the transition from guide hard work to mechanized production, driven by way of innovations consisting of the steam engine and mechanized textile machines.

1.2 *Industry 2.0 (late nineteenth century)*

The Electrification Revolution – Marked by using the extensive adoption of energy and the development of electrically powered equipment, main to accelerated productivity and business growth.

1.3 *Industry 3.0 (mid-20th century)*

The virtual Revolution – described via the advent of computer systems and the virtual time into business procedures, enabling automation and in addition increases in performance.

1.4 *Industry 4.0 (present-day)*

The Cyber physical Revolution – characterized by the incorporation of virtual expertise, which include the Artificial Intelligence (AI) [8] [18] and Internet of Things (IoT), with human procedures, developing interconnected, smart systems.

1.5 *Industry 5.0 (future)*

The Human-Centric Revolution – Envisions a future in which humans and machines work collectively collaboratively, with a focus on improving human talents and creativity and leveraging technology to support and increase human capabilities.

Every industrial revolution has brought about good-sized modifications within the way we work, live, and engage with the era, and Industry 5.0 is poised to similarly remodel industries with the aid of setting people in the middle of technological improvements.

2 RELATED WORK

Recent studies have emphasized the significance of Industry 5.0 as a transformative technique to production that prioritizes the position of human beings together with superior technology. Industry 5.0 constructs upon the muse of Industry 4.0 but shifts the point of interest from automation to collaboration among human beings and machines. This shift is seen as critical for addressing challenges consisting of process displacement and ensuring that technological improvements gain society as an entire. One study by way of Smith *et al.* [1] explores the capacity of Industry 5.0 to revolutionize the manufacturing region by emphasizing human creativity, hassle-fixing capabilities, and emotional intelligence. The authors argue that with the aid of integrating those human qualities with superior technology along with synthetic intelligence and robotics, industry 5.0 can cause greater sustainable and socially accountable manufacturing practices [11].

Some other look at via Jones and Brown [2] discuss the concept of "human-targeted automation" in the context of Industry 5.0, emphasizing the want to lay automation systems that enhance instead of update human capabilities. The authors endorse a framework for designing such structures, highlighting the significance of consumer-entered layout standards and continuous human-device interaction. The idea of Industry 5.0, focusing on the human-centric destiny of manufacturing, builds upon preceding commercial revolutions and present-day production developments. Industry four.0, frequently known as the Fourth Business Revolution, introduced cyber-bodily structures and automation into manufacturing procedures [3]. At the same time as Industry 4.0 emphasized the incorporation of virtual technology, industry 5.0 took a step further by highlighting the significance of human capabilities and collaboration in manufacturing [4].

Preceding research has explored the implications of Industry 4.0 in the workforce, highlighting the need for upskilling and reskilling of people to conform to new technology [5]. However, Industry 5.0 shifts the focal point from replacing human employees with machines to enhancing human-gadget collaboration [6]. One related work that bring into line with the concept of Industry 5.0 and its recognition of human-centric manufacturing remains a study by Kagermann *et al.* [7] observed generally makes a specialty of Industry four.0, it lays the groundwork for the thoughts behind Industry 5.0, in particular, the mixing of human abilities and creativity with superior technologies in production [9,10].

3 PROPOSED WORK

To advise a technique for Industry 5.0: The Human-Centric future of manufacturing, it can outline a framework that integrates human abilities with advanced technology. This framework's objectives are to improve productiveness, creativity, and normal efficiency in manufacturing techniques. Industry 5.0 characterizes a vision for the future of manufacturing that emphasizes the collaboration between humans and machines. It builds upon the ideas of Industry 4.0 but places more consciousness on the function of human people within the production system. Industry 5.0 pursues to combine the strengths of both human beings in addition to machines, leveraging advanced technology to improve human abilities and creativity [17].

3.1 *Key aspects of industry 5.0*

Human-Centric method: Industry 5.0 puts people in the middle of the production process, highlighting the reputation of human competencies, creativity, and then choice-making.

3.1.1 *Collaborative robotics*

in preference to changing human workers, robots in Industry 5.0 are designed to work alongside people, supporting them in duties that require precision, power, or persistence.

3.1.2 *Advanced technology*

industry 5.0 leverages technology inclusive of synthetic intelligence, augmented reality, and the Internet of Things to create smart, interrelated manufacturing structures.

3.1.3 *Customization and flexibility*

With the help of advanced technologies, industry 5.0 allows greater customization and versatility in manufacturing approaches, making an allowance for more customized products and faster reaction to marketplace demands.

3.1.4 *Sustainability*

Industry 5.0 goals to be greater sustainable through optimizing useful resource use, decreasing waste, and minimizing environmental effects.

Ordinary, industry 5.0 signifies a transferal in the direction of a more human-centered and sustainable approach to production, wherein technology is used to enhance human abilities and improve typical productivity and efficiency.

Figure 1 illustrates various technological trends that are considered to be key enablers for the concept of Industry 5.0. These enablers are:

- Exoskeletons
- Drones
- Industrial Blockchain
- Mixed Reality
- 5G and Beyond
- Additive Technology

Each enabler is represented by an icon within a circle and all are connected to the central larger circle that reads Top Technology Enablers of Industry 5.0 [15,16].

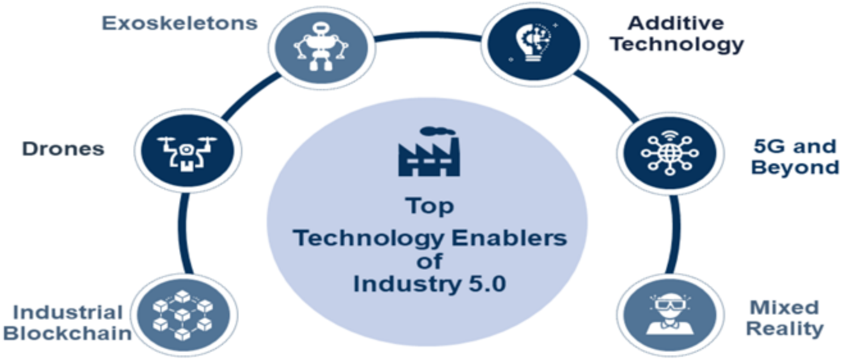

Figure 1. Technology Enabler of Industry 5.0.

3.2 *Some key technology enablers of Industry 5.0*

3.2.1 *Human-machine collaboration*

develop collaborative structures wherein people and machines work collectively seamlessly. This includes designing robots and automation systems that can assist and collaborate with human workers adequately and successfully.

3.2.2 *Skill enhancement*

enforce schooling packages and talent development tasks to enhance the capabilities of human employees. This consists of education in new technologies, problem-solving abilities, and creativity enhancement.

3.2.3 *Advanced technologies integration*

integrate advanced technology which includes artificial intelligence, system mastering, and augmented fact into manufacturing methods. These technologies can assist human workers in choice-making, problem-solving, and procedure optimization.

3.2.4 *Customization and flexibility*

expand production systems that may quickly adapt to changing product requirements and purchaser demands. This includes designing flexible production lines and agile production methods.

3.2.5 *Sustainability and environmental impact*

implement practices and technology that lessen environmental effects and sell sustainability. This includes the usage of renewable strength assets, lowering waste, and optimizing aid use.

3.2.6 *Data-driven decision making*

make use of information analytics and actual-time monitoring to make informed decisions and optimize manufacturing tactics. This involves gathering and reading information from sensors, machines, and human workers to discover areas for improvement.

3.2.7 *Continuous improvement and innovation*

Foster a subculture of nonstop development and novelty in the corporation. Hearten people to recommend new thoughts also expertise that can enhance manufacturing procedures and product excellence.

3.2.8 *Human-centric design*

layout production procedures and systems with a focus on human elements which include ergonomics, safety, and usefulness. This involves designing workstations, gear, and systems that might be at ease and green for human people.

With the aid of employing this proposed approach, manufacturers can leverage the strong points of both humans and machines to create more efficient, effective, and sustainable production surroundings in line with the standards of Industry 5.0.

4 RESULTS AND DISCUSSION

The Human-Centric destiny of producing could usually gift and interpret the findings of the research. Start utilizing presenting the key findings of the have a look at, focusing on the implementation and effectiveness of human-centric tactics in manufacturing. This will consist of quantitative data, qualitative observations, and case research. Examine the effects of the human-centric method with traditional manufacturing techniques or preceding business revolutions. Highlight any upgrades in productiveness, performance, or employee delight. The implementation of Industry 5.0 concepts has impacted diverse components of producing processes, including manufacturing output, pleasant manipulation, and flexibility. Offer precise examples or case research to demonstrate those factors. Analyze the role of technology enablers, inclusive of collaborative robotics, synthetic intelligence, and augmented reality, in facilitating human-centric manufacturing. State how these technologies were integrated into the manufacturing environment and their effectiveness in improving human-gadget collaboration. Explore the influence of human-centric tactics happening worker pride, commitment, also nicely-being. Express any modifications in activity roles, skill necessities, or working environments on account of the adoption of Industry 5.0 standards. Challenges or barriers encountered in the course of the implementation of human-centric production strategies. This can consist of technical constraints, organizational obstacles, or resistance to exchange. Destiny research guidelines and possibilities for in addition improvement in human-centric. This could consist of exploring new technology, refining existing processes, or addressing ultimate challenges. Summarize the key findings and implications of the study, highlighting the significance of human-centric methods in shaping the destiny of manufacturing. Exchange the broader implications for industry, society, and the economic system.

5 CONCLUSION

Industry 5.0 characterizes a tremendous evolution in industrial, transferring the focal point towards human-centric techniques that highlight cooperation between humans and machines.

Through integrating superior technology along with collaborative robotics, artificial intelligence, and augmented fact with human capabilities and creativity, Industry 5.0 permits extra green, bendy, and sustainable manufacturing processes. The implementation of Industry 5.0 standards has been shown to improve productivity, quality management, and worker satisfaction in production environments. By empowering employees and improving their abilities, industry 5.0 is poised to force innovation and competitiveness within the production area. However, the implementation of Industry 5.0 also provides challenges, consisting of the need for upskilling and reskilling workers, addressing technical constraints, and overcoming organizational limitations. Addressing these demanding situations may be essential for the successful adoptation of Industry 5.0 in manufacturing. Searching in advance, Industry 5.0 can revolutionize manufacturing by creating extra human-centric, efficient, and sustainable production systems. By embracing the ideas of Industry 5.0, manufacturers can position themselves for success inside the hastily evolving business panorama.

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Machine learning-driven predictive maintenance for enhanced production management in the manufacturing industry

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ABSTRACT: In the present study, the preventive maintenance strategy to which an innovative solution was developed administrates on industrial weaving machine. These three different machine learning models, Support Vector Machines (SVM), k-Nearest Neighbors (KNN) and Recurrent Neural Networks have demonstrated amazing predictive abilities when used in concert with a sensor system spread out over five separate machines. From the results in the table above, we can see that all models depicted remarkable accuracy, precision, recall and F1 scores which would indeed prove to be beneficial in terms of minimizing maintenance costs, unplanned downtime while maximizing production efficiency. The remarkable accuracy of 91.1% for SVM, 95.6% for KNN and 93.3%, obtained by RNN on test dataset underlines how artificial intelligence can revolutionize predictive maintenance as we know it today. The study is a proactive data driven approach that will insure continuous performance of critical equipment It would revolutionize the way industrial maintenance is and will be carried out. The larger industrial environment's productivity and competitiveness are greatly influenced by the efficiency and reliability of equipment. Therefore, this study is a major advance towards a future where predictive maintenance follow state-of-the-art production processes with the help of intelligent machine learning algorithms.

Keywords: Industrial maintenance, Machine Learning, Deep Learning Models, performance score

1 INTRODUCTION

Analytical data and machine learning-based applications are contributing to different industries' evolution, predictive maintenance is one of the elements essential when using an industrial

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machinery properly predictive maintenance being applied to the textile industry, a sector not renewing because of the global demand. With the incorporation of smart sensors and machine learning algorithms, real-time data analysis is being developed as a way to anticipate maintenance needs in looms enabling downtime and associated costs to be significantly reduced. The development of Computerized Maintenance Management Systems (CMMS) and condition-based monitoring (CBM) has led to predictive maintenance, while the ability for machines to learn, itself a facet of artificial intelligence has transformed methods crucially based in machine learning. Develop using machine learning methods like Recurrent Neural Network (RNN), Support Vector Machine (SVM) and k-Nearest Neighbor algorithm to analyze data, recognize patterns and predict maintenance needs. The challenges include the quality of data and how it can be integrated into present industrial ecosystems. “That said, the advantages that predictive maintenance brings cannot be understated — and they are as applicable to supply chains as they are to manufacturing schedules and production efficiency,” he also noted.SVM for classification problems and the k-Nearest Neighbors to identify when a current group of similar maintenance data is due in the future Your use of Recurrent Neural Networks to handle sequential data will allow you to learn from tendencies in streams of sensor information. “All of them, means cutting edge technologies that are changing in depth the way industrial maintenance has been done so far and improving massively equipment reliability and overall operation”, he said. Advanced sensor systems and machine learning algorithms in combination are venturing new opportunities within the textile industry that were previously impossible at traditional production to make their equipment more reliable and efficient in order to have unimpeded manufacturing processes, to increase industrial efficiency and competitiveness in the global market, predictive maintenance is pivotal. The wide range of these disruptive technologies across industries is solidifying the predictive maintenance landscape, offering opportunities for innovation and growth in several sectors.

2 METHODOLOGY

Effective maintenance management is vital in the manufacturing industry to attain lower downtime, lengthen equipment life and enhance production practices. The trend over the last years has been rapid replacement of reactive approaches for maintenance to more advanced methods which prevent incurring downtime along with related costs and overheads while increasing equipment lifecycle. Different maintenance management activities are performed so as to foster the practice of production management in the industrial sector. In this section, a comparison for different possible alternatives will be discussed that includes reactive, planned, proactive and predictive maintenance options. Reactive maintenance Long employed in manufacturing production environments, this approach which is often (and perhaps cynically) known as “breakdown maintenance,” is called reactive maintenance. This approach involves addressing the issue with whatever assets just when they breakdown or beginning showing wears. Many times reactive maintenance results in unexpected downtime and increased costs of repair as well as results in lower efficiency overall, although it may seem cost-effective initially. Although a traditional lean or a Kanban system will not always suit our chaotic modern manufacturing environments where the demand is relentless to deliver time-dependent production. Planned Maintenance That official term known as “scheduled maintenance” is better described in other circles as “planned maintenance.” It involves periodic inspections and maintenance activities performed based on the equipment manufacturers’ recommendations and past experience about its functionality. Due to the need to make certain that production processes are not interrupted by unplanned activities, these steps are often performed with downtime or planned shutdowns. On the other hand, it is possible to too much of planned maintenance that also may elevate costs and scheduled on longer intervals than necessary for a piece of equipment”. Proactive maintenance, on the other hand, attempts to prevent equipment failures by addressing underlying issues and utilizing predictive methods. It includes things like condition-based monitoring, which involves using sensors and data processing to assess the health of equipment. The purpose of the early warning system is to identify symptoms of wear and tear early, so timely maintenance can be performed to prevent an unexpected breakdown. One feature that can cut repair expenses and reduce downtime, without compromising on reliability is pro-active maintenance. “But there may be a role that is still sort of belter in terms of … preventive rather than predictive. Predictive maintenance Optimal maintenance approach = predictive It combines cutting-edge tech such as machine learning to predict potential malfunctions of machinery. Predictive maintenance may accurately predict future maintenance requirements based on analysis of historical and current data. “Given that it minimizes the risk of unplanned downtime, extends the life of equipment and optimizes maintenance resources, this is an approach ideal for modern industrial businesses hoping to achieve optimal levels of efficiency and cost-effectiveness.”

3 MACHINE LEARNING BASED MAINTENANCE

The efficiency and competitiveness of the manufacturing industries might be hampered by the inherent shortcomings of traditional maintenance systems, including reactive, scheduled, and proactive maintenance. Despite being a widespread strategy, reactive maintenance frequently results in expensive downtime and high repair costs. Even though it is more regimented, planned maintenance still uses generic timetables and can be expensive because of unneeded work. Although proactive maintenance is an improvement, it still lacks very precise prediction skills, and resources are frequently devoted to preventive tasks. On the other hand, using machine learning to maintenance has many benefits. With the help of resource allocation and maintenance schedule optimisation, machine learning algorithms can analyse enormous datasets to predict equipment breakdowns with surprising accuracy. This results in significant cost savings. Machine learning increases the overall competitiveness of manufacturing sectors by extending equipment lifespan, decreasing downtime, and increasing production efficiency. Additionally, it produces priceless insights and helps to improve worker safety, offering businesses a crucial edge in today’s hectic and competitive industry.

4 WORKING OF THE PROPOSED SYSTEM

Machine learning-based predictive maintenance management for a weaving machine represents a significant advancement in ensuring the longevity and continuous operation of crucial industrial machinery. This system, consists of a variety of sensors that are thoughtfully positioned all around the weaving machine. These sensors include proximity sensors to detect movement, temperature and vibration sensors, vibration sensors at various locations, and temperature and proximity sensors at the motor. These sensors are crucial for keeping track of the machine’s performance and identifying any problems as soon as they arise. These sensors record all of the weaving machine’s operations as it regularly runs by continuously collecting data. The baseline for assessing the machine’s condition is provided by these preliminary findings. This system is notable for its exceptional ability to spot sensor reading anomalies, which could be an indication of impending failures. In the event of a machine failure, the sensors instantly identify and log any unusual changes in their readings, providing crucial data for research. These alterations might manifest as, among other things, temperature increases, strange vibrations, erratic motion, and changes in current and power consumption. This vital information is gathered and analysed in order to pinpoint the precise trends that lead to machine failure. For the purpose of creating a trustworthy predictive maintenance model, the system collects and stores this dataset for a predetermined amount of time, frequently a week or more. The machine learning algorithms that are in charge of precisely estimating maintenance needs are trained using this dataset. This dataset was processed using machine learning methods like Support Vector Machines (SVM), Recurrent Neural Networks (RNN), and k-Nearest Neighbours (KNN) to find correlations between sensor readings and breakdown occurrences. SVM is skilled at classifying a variety of data types, while RNN excels at identifying sequential data patterns. KNN makes use of proximity-based learning to predict outcomes. These algorithms enable the system to generate predictions based on recent sensor data, learn about the characteristics of the weaving machine, and adapt to those characteristics. In reality, throughout its typical working cycles, the machine’s performance is constantly tracked.

The trained machine learning model runs in the background and compares the most recent sensor results to the patterns and trends discovered during training. The system promptly sends out a maintenance warning if any deviation from the anticipated data occurs. The entire working of the proposed system is shown in Figures 1(a) and 1(b).

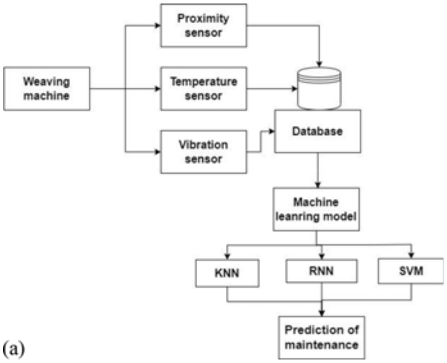

Figure 1(a). Working of the proposed system.

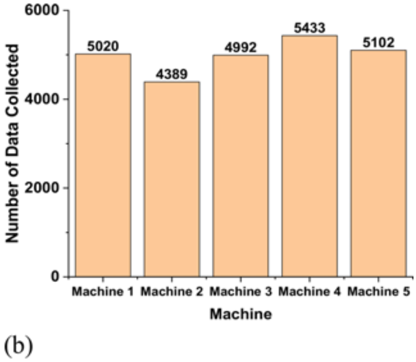

Figure 1(b). Dataset used in this research.

These notifications are very useful because they spot potential issues before they become serious failures. Due to the early notice, maintenance staff may react quickly to resolve the problem, minimizing downtime and averting pricey repairs. According to the severity of the deviation, the system may prioritise maintenance tasks, ensuring that serious problems are fixed right away and scheduling less urgent maintenance for more convenient times. The advantages of this machine learning-based predictive maintenance solution are numerous. It extends the life and dependability of the weaving machine and boosts operational efficiency. In the end, it increases manufacturing output by lowering maintenance costs, unscheduled downtime, and unexpected maintenance operations. The technology runs in real-time, allowing it to adapt to changing conditions and make accurate projections even as the machine ages and deteriorates.

Five machines have sensor systems installed as part of the proposed system to gather data fo predictive maintenance. The data that the various sensors on each of these machines collect is essential for enhancing the machine learning algorithms used in the predictive maintenance system. The dataset sizes for each of the five machines is essential information about the volume of data that is available for model development and training. Machine 1 has collected a dataset of 5,020 sensor readings and associated performance information. This dataset was created by continuously observing the machine's sensor outputs throughout all of its operational cycles. The machine learning algorithm can use this rich source of 5,020 data points to identify the precise patterns and trends relating to the first machine.

Comparable datasets with 4,389, 4,992, 5,433, and 5,102 sensor readings each for Machines 2, 3, 4, and 5 are also available, along with performance information. Data is typically split into training and testing sets in the context of machine learning and predictive maintenance in order to assess the effectiveness of the model. In this instance, testing uses 70% of the machine data, and training uses 30%.

5 MACHINE LEARNING APPROACHES

The pioneers present a predictive maintenance system of automobile engines by using machine learning methods, such as Support Vector Machines (SVM), Recurrent neural networks (RNN) and K-Nearest Neighbors (KNN). SVM can be useful for classifying data and specifically, it can be used in certain applications related to classification of sensor readings which help us identify whether an engine will fail or not. Because RNN is good at processing sequential data and recognizing the time dependency in music data stream. In the case of KNN, a prediction occurs based on similar data points to each other. This can be especially useful for trends within musical data These techniques have to be trained using historical (non-failed) problems, so that they can detect patterns which might lead to failures. Once the models are trained, they can be used for real-time performance monitoring and alerting of scheduled maintenance when anomalies occur. it works by taking new sensor data and comparing it to the patterns in the past. That said, experts are able to "forecast" malfunctions, unexpected changes of temperature or vibrations and many more possible signals that a sensor might consider in short, with the help of this machine learning algorithms we have a proactive approach for automotive engine maintenance which will avoid damages that can be avoided.

6 RESULT AND DISUCSSION

The study used machine learning models for predicting maintenance demands based on sensor data of five machines an effective way. Support Vector Machine, K-Nearest Neighbors and Recurrent Neural Networks models earned high accuracy rates spreading between 91.1% to 95.6%. These models adequately predicted the maintenance needs, evaluated on precision, accuracy, recall and F1 score. "The confusing matrix showed reduced false alarms with fewer missed maintenance events and accurate predictions," they said. "Altogether, the results obtained reveal that machine learning indeed has a potential to boost predictive maintenance in manufacturing," he writes. "In a well-known way: less downtime and costs but above all safer machinery." Performance Score is shown in Figure 2.

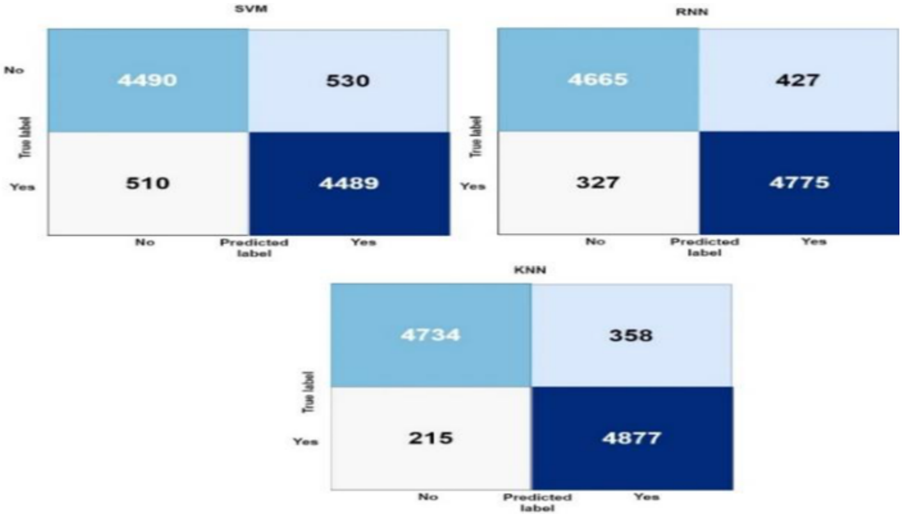

Figure 2. Performance score.

7 CONCLUSION

This paper has progressed the PM technique for loom machines based on a sensor system after 5 machines and three ML models: SVM, KNN and RNN. All of them have hot precision, recall, accuracy and F1 scores in that there are 91.1%, 95.6% the level of accuracy,93.3% accurate respectively These findings underscore the possibilities they open for eliminating unplanned downtime, decreasing maintenance expenditures and increasing overall production efficiency This work serves as a precursor for proactive, data driven maintenance methodologies used by machine learning in combination with sensor real time sensor data to enable critical machines operate hassle free. This is the future that can be envisaged whereby predictive maintenance can lead to a step change in equipment reliability and operational efficiency within manufacturing industry.

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A comprehensive study on the harmful effects of the smoking on human beings

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ABSTRACT: Smoking entails inhaling and exhaling tobacco smoke produced through burning tobacco. The tobacco plant contains billions of toxic substances like nicotine, tar, and carbon monoxide. Such substances can severely affect several systems of the human body, resulting in various complications and illnesses. These illnesses fall into two main categories. Respecting physical health, they only cause illnesses in their respective systems while also affecting the mental aspect of the human body. Some of the negative effects of cigarette smoking are on Respiratory system, cardiovascular system etc. Due to the inhalation of tobacco smoke, the airways become inflamed and produce extra mucus, irritants morb irritants, and extent. The heart and blood vessels produce plaque that narrows and causes difficulties for the blood have to flow through them. Other health consequences of smoking are increased risk of disease cancer. Smoking results in increased risks of several kinds of cancer. According to statistics, smoking is the leading cause of lung cancer. Smoking leads to many other types of cancer include throat and mouth, esophagus, pancreas, likely stomach, and some cancer-specific liver cancer. Health affected factors, other factors, deceased by smoking and suggestions are given in this manuscript. This manuscript will very helpful for all the persons, societies, nations and researchers. This study will very helpful to know about the different impacts of smoking regarding health or other factors and family members also. By the help of this manuscript a smoker can follow the suggestions and awareness regarding the consequences of smoking.

Keywords: Smoking, Effects, Cancer, Public health, Society

1 INTRODUCTION

Smoking is a common human habit that has devastating effects on health. It is one of the leading risk factors for developing chronic diseases, including cancer. Even though the hazards posed by smoking have been widely documented, smoking is still a significant human behavior and activity worldwide. Today, the smoking of a cigarette/cigar has become a common fashion all over the world. From when a cigarette is lit, it releases a complex mixture of over 7,000 chemicals, many of which are toxic and dangerous to the body. Even though the act of smoking might trigger temporary happiness or stress relief to an individual, the long-term negative consequences of smoking are profound and widespread. Smoking affects almost every organ system in the body, leading to all manner of health issues and a decreased lifespan. This paper reviews the health impact of smoking and seeks to establish the case for eliminating the habit altogether. Tens of millions of people live with numerous short term and long-term diseases and complications arising from smoking [1–3]. The habit exposes non-smokers to environmental tobacco smoke through second-hand smoking with the majority of the victims being young civilians. While many people recognize the health effects of smoking, the habit also has potential social and economic spill over. Smoking is also an environmental concern that degrades ecology and worsens air pollution. Many people take up this negative habit without fully understanding the extent of the damage to their health, financial standing, and their immediate families and friends. Many others smoke due to bodily pleasure, which explains the many

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potential benefits over the short term. Dangers associated with smoking cigarette only become apparent after years of consumption. Thus, there is a need to ban smoking wholly to preserve the health, life, social status, and wealth of consumers. Furthermore, second hand smoke is also harmful to non-smokers, especially high-risk populations, like children, pregnant women, and people with comorbidities. Besides its enormous impact on physical health, smoking is associated with considerable social, economic, and environmental consequences. Tobacco use expands opportunities for ill forces, undermines the fabric of payers, throws down extra gauntlets over vast lands with suffering consequences. Smoking remains the leading cause of preventable death worldwide despite effective anti-smoking campaigns, due to addiction and morbidity caused by the youth-targeted tobacco industry. Solutions to this multifaceted problem need attention in the form of prevention, cessation, policy interventions, advocacy efforts awareness creation, providing smoke-free environment and cessation support for tobacco control to reduce tobacco attributable diseases and build a healthier tomorrow. [4–6].

2 LITERATURE REVIEW

2.1 *Effects of smoking on human health*

Before 1950s people were not much aware by the bad effect of smoking. Smoking was still considered a normal activity, and knowledge of its adverse effects was very limited [3]. In 1950s this changed with the first large scientific papers linking smoking with lung cancer and other respiratory conditions. In his collaboration with A. Bradford Hill, Richard Doll published the report that summarized their work on the connection between the two in 1950. In the duration of 1960s Additional research confirmed the link between smoking and diseases like heart disease, stroke, and chronic obstructive pulmonary disease. In the duration of 1970s Governments applied regulations to help curb tobacco consumption, such as using warning labels on the cigarette boxes and controlling advertising. In 1980s the reports given by the Surgeon General in the U.S spread the risks of the passive smoking and, thus, many public areas banned indoor smoking, which worsened the experience of the smokers. In 1990s the effect of cigarette smoking on pregnancy became publicly recognized, and subsequently the number of cases of miscarriage, low and extremely low birth weight, and early parturition began to grow. Easier access to antismoking programs and medication, more countries started smoking cessation programs, smoking rates began to decline in number of population were affected in 2000s. Popularity of E-cigarettes, which were viewed as less harmful than the regular ones in long term; however, nothing is known yet in 2010s. From the duration of 2020s to 2022, continued increase in tobacco product price due to taxes, bans on smoking advertisements, regular occurrence of lectures about smoking and influence on the human from it [5,6]. These years of analytics proved that smoking ranked as one of the key causes of avoidable deaths across the globe that resulted from numerous eventualities and diseases. Millions of people succumb to these conditions each year, triggering the need for public policies to lessen the prevalence of smoking and inflict less damage on people [7,8].

3 IMPACT OF SMOKING ON SOCIETY

The impacts of smoking on society are myriad and multifaceted, affecting different dimensions of public health, economics, and social relationships. The following is an overview of some of these impacts:

3.1 *Public health (illness) impacts*

Smoking is the leading cause of preventable illness and death across the globe. The disease is dead-linked to numerous health conditions, including lung cancer, heart attacks, respiratory illnesses, and strokes, among other conditions. The effects of such illnesses related to smoking have constrained multiple public health systems as smoking-related diseases overwhelm these systems.

3.2 *Economic costs (Health care expenses)*

The economic effects of smoking are enormous and go further the health care expenses. Lost earnings due to death, sickness, and inability as a result of smoking and second hand smoke exposure tally up to billions of dollars every year. In addition to the workers killed, tobacco farming and the use of land cultivates a toxic product and utilizes every year hundreds of millions of acres land.

3.3 *Second hand smoke exposure*

Even non-smokers are damaged from second hand smoke exposure, which encompasses a broad range of dangerous substances. Second hand smoke has been related to the onset of cardiovascular diseases, lung infections, and asthma, particularly in young children and those who are already ill.

3.4 *Social impacts*

Smoking may reinforce inequality as certain populations are more prone to smoke and profit from income economically. It foments unhealthy habits across individuals who use them and their society.

3.5 *Impact on Environment*

The manufacturing, distribution, and disposal of tobacco compounds create a significant environmental impact. Various tobacco farming, manufacturing, and discarded cigarette butts pollute the atmosphere and destroy several lands which affect the animals.

3.6 *Policy and regulation*

To mitigate the effect of smoking on society, tobacco control policies and regulations are supporting. The aim of this society is to minimise the smoking rates and save (protecting) the public health [9–11].

Table 1. Health risks associated with smoking.

Diseases by smoking	Symptoms
Lung cancer	Smoking is the primary risk factor for lung cancer, accounting for the majority of cases. Smokers are 25 times more likely to get lung cancer than non-smokers. The toxic ingredients in tobacco smoke damage the lung's lining cells, which can develop into tumors.
Cardiovascular diseases (CVD)	Smoking is one of the biggest risks for coronary artery disease, heart attack, stroke, and peripheral artery disease because it damages blood vessels, encourages arterial plaque formation, and raises blood pressure and heart rate. Smoking is one of the significant risk factor of heart attack and stroke and it causes approximately 10% of deaths globally due to CVD.
Chronic obstructive pulmonary disease COPD)	1970s and beyond: The condition of COPD was connected to smoking. Smoking is to blame for 90% of COPD cases. COPD is a significant cause of morbidity and mortality worldwide.
Other Cancer apart from lung cancer	Smoking has also been linked to cancers of the mouth, throat, esophagus, larynx, pancreas, bladder, kidney, cervix, Colorectal cancer and stomach, to mention a few. The toxins in tobacco smoke infiltrate the body and damage cellular DNA, causing cells to divide out of spur. Most studies began with the 1970s, which have established associations between smoking and various cancers in the upper respiratory and digestive tracts. Smoking tobacco is associated with increased cancer risk, which is correlated with smoking duration and intensity. Evidence of smoking's correlation dates back to the 1980s; smoking tobacco is one of the major risk factors; smokers are about three times more likely to suffer from bladder cancer. Since the 1990s, more and more research has indicated that smoking is correlated with an increased risk; smoking tobacco is responsible for one's being predisposed to colorectal cancer, which is directly proportional to the total lifetime usage of tobacco.
Diabetes	There are multiple studies that evidenced the increased risk of developing type 2 diabetes; the exact mechanism is challenging and includes activities on several fronts, such as insulin resistance and inflammation.
Respiratory diseases	Several respiratory diseases are frequent in smokers, particularly chronic bronchitis, emphysema, and chronic obstructive pulmonary disease. These conditions are characterized by limited breathing, coughing, inability to breathe, and a tendency to have respiratory illnesses like pneumonia more often than non-smokers due to the destruction of respiratory cells. 1960s and beyond: smoking's connection to lung disease grew clearer. Quitting smoking

(*continued*)

Table 1. Continued

Diseases by smoking	Symptoms
	has been demonstrated to decelerate respiratory disease progression while also improving clinical symptoms.
Reproductive health	Smoking has diverse negative effects on reproductive health, including low conception rates, erection problems in males, and pregnancy problems such as abortion, preterm birth, low birth weight, and fetal malformations.
Dental and oral health or structure	Smoking is a significant danger for oral diseases ranging from gum toal downturn, dental caries formation, and oral cancer.
Vision loss or impairment	Cataracts, age-related macular damage, and diabetic retinopathy have also been linked to smoking.
Bone health	Smoking is also a significant danger because smoking causes post-menopausal osteoporosis and bone fractures.
Rheumatoid arthritis	Research indicated that smokers are more likely to develop rheumatoid arthritis; ceasing smoking reduces the risk; the level of risk reduction is comparable to a non-smoker in several years.

4 HEALTH RISK

Smoking is linked to a wide range of deleterious health consequences that affect almost every body organ system. Some of the most important health risks associated with smoking is given in Table 1.

4.1 *Harmful effects of smoking other than health*

A comprehensive tobacco control approach is necessary, as smoking does not have the well-documented detrimental effects on health but also exerts various negative influences on the individuals and society as a whole. Such effects impact not only the physical health of smokers but also have social, economic, environmental, and legal implications. Specifically, the following detrimental effects of smoking on the individual can be distinguished: social stigma, environmental pollution, fire hazard, economic costs, tobacco industry marketing approach, legal and regulatory issues, family and relationships, and workplace productivity. The most salient negative individual effect of smoking, social stigma, is also associated with the worsening image of smoking in modern societies due to increased awareness of its deadly effects. Moreover, environmental pollution is also significant, as it includes the pollution caused by toxic smoke and non-biodegradable cigarette butts. Finally, smoking imposes both direct and indirect economic burdens, which undermine the sustainable development goals of the modern society [12].

4.2 *Physiological effects of smoking while driving*

The physiological effects of smoking on the human body also play a crucial role in determining a driver's ability to safely and properly operate a motor vehicle. The following are some ways in which smoking affects the performance of driving:

4.2.1 *Decreased reaction time*

Smoking has been shown to have an impact on reaction time. Reaction time refers to the amount of time it takes a driver to respond to a stimulus such as a sudden change in traffic or an object in the road. Nicotine, the addictive compound in cigarettes, is a stimulant at first, but people generally grow addicted to it and experience withdrawal symptoms. Some of these symptoms include a reduced reaction time.

4.2.2 *Impaired vision enables reductions in vision*

For one, smoking causes dryness and eye irritation. Furthermore, smoking is a known risk factor for several eye illnesses, including cataracts and ARMD (Age-related macular degeneration), both of which may result in vision reduction. It is more difficult for motorists to identify dangers and respond appropriately when visibility is reduced.

4.2.3 *Decreased levels of concentration*

Smoking has a detrimental impact on one's ability to focus. Smoking withdrawal symptoms such as irritability and the inability to focus even more exacerbate the issue.

4.2.4 *Increased rates of the heart and blood pressure*

As a result of the stimulant effects of nicotine, smoking could generate temporary increased heart rate and blood pressure. In normal conditions, this is less of an issue for healthy persons, but this can worsen cardiovascular overload while physically exerted.

4.2.5 *Respiratory results*

Smoking makes it more difficult to breathe while driving by making it more difficult to breathe for those with respiratory issues such as asthma or COPD. One's ability to focus is also likely to be impaired if smoking triggers of breath or extensive cigarette smoke causes the cough.

4.2.6 *Risk of drowsiness*

According to sources, smoking disrupts sleep and causes people to be drowsy. Fatigue is a major contributor to drowsiness due to the lowered alertness, concentration, and slower response times while driving in unhealthy states. In the end, the physiological impact of smoking on the human body influences the driving performance of a driver. Such knowledge is vital for drivers to comprehend, and they should be aware of the actions to take to avoid smoking. These actions may include quitting smoking or not smoking when driving and getting help to stop smoking [13].

4.3 *Indirect effects of smoking on family members*

The indirect effects of smoking on family members are just as important as the direct effects of smoking, with potentially significant repercussions for the physical health and emotional well-being of family members. These indirect effects may include the following:

4.3.1 *Second hand smoke exposure*

family members, particularly children and non-smoking partners, are exposed to the hazardous effects of passive smoke in the home environment. Second hand smoke contains a mixture of toxic chemicals and carcinogens that can cause non-smokers to get sick with respiratory issues, cardiovascular disorders, and several types of cancer.

4.3.2 *Increased health risks*

Children raised in a smoking household are more likely to catch respiratory illnesses, exacerbate asthma, and suffer other health problems compared to children who are not second hand smokers. Exposure to prenatal second hand smoke can be more dangerous, resulting in low birth weight, preterm birth, and infant development issues. Maternal passive smoke exposure has also been linked to stillbirth and childhood neurodevelopmental problems.

4.3.3 *Parents who smoke model smoking*

Parents unintentionally influence their kids, who are less hostile to smoking, by smoking. Children are more likely to try cigarettes if their parents smoke and see smoking as an acceptable and ordinary behavior.

4.3.4 *Financial strain*

Smoking can drain a family's financial resources by necessitating the purchase of cigarettes and causing smoking-related healthcare expenses.

4.3.5 *Emotional impact*

Family members are likely to suffer emotional distress and concerned regarding the deteriorating health condition. Depression, helplessness, and anger toward his or her family can result as smokers refuse to stop.

4.3.6 *Disruption of daily routines*

Smoking, particularly if family members do not want to be in a passive environment, can throw routines off balance in general and lead to interruptions [14,15].

5 SUGGESTIONS

As we know that smoking is injurious for health. Many recommendations suitable for quitting the smoking are as follows:

- Find support either from a support group, friends, or family.
- The government can make some measures for the restrictions of smoking. These measures may include tobacco taxation, smoke-free laws, advertising restrictions, and public education campaigns to raise awareness about the dangers of smoking.
- Use traditional ways to avoid withdrawal symptoms by consulting a healthcare provider to prescribe chewing gum, lozenges, patches, or inhalers.
- Be ready to find ways to avoid cigarettes by substituting them with physical sports activities, training oneself to relax in another way, or distracting oneself with other hobbies.
- Establish the right approach to your to-be-experience timeline and prepare for the biggest challenges.
- Never underestimate milestones and reward oneself for positive outcomes in terms of smoking cessation. Reducing smoking; those who are not yet ready to quit smoking for good but aim at reducing smoking habits.

6 CONCLUSION

In summary, smoking has a deep and wide-ranging impact on society and human health including public health, economic, environmental, social and equity impacts. The available evidence affirms that the consumption of smoking tobacco is responsible for other severe health problems. Solving a smoking problem as a global public health challenge necessitates decisive and preventive action based on evidence. Such actions include implementation of proven tobacco demand reduction methods which include tobacco use prevention, regulation of tobacco supply, effective cessation services, and increased cigarette taxation. Moreover, acting to solve social determinants of health is of considerable importance. Such actions include public education, campaigns aimed at increasing awareness of the health effects of smoking, and restrictive working environments. Concurrently undertaking all these actions, society can reduce the inequality and poor health outcomes caused by smoking and create a world in which is easier to be smoke-free.

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A comprehensive survey on the emergence of computer science in biotechnology

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ABSTRACT: This research paper will provide a comprehensive understanding of how the fusion of computer science and biotechnology has revolutionized biological research, contributing to the development of innovative solutions for various sectors, including healthcare, agriculture, and environmental sustainability. This study will provide you with a clear understanding of how bioinformatics, genomics, and computational tools contribute to the progress of biotechnology.

Keywords: Biotechnology, Computation, Data manipulation, Bioinformatics, Genome, DNA sequencing

1 INTRODUCTION

Biotechnology is the section of biology that uses different computation tools and different techniques to create new products from raw material. The goal of biotechnology is to benefit humankind. Biotechnology makes the use of biological process to create new technical solutions by creating different artificial devices and transforming the biological molecules design. In early 1970s, there started revolution in molecular biology. The storing to large data-base and analysis them had become difficult. The using of computational for data manipulation and analysis has simplified the work of biotechnologists. In the field of biotechnology, computers are essential because they allow professionals and researchers to expedite complex procedures, analyze massive datasets, and quicken the rate of scientific discovery. Computers are now an essential part of any biotechnology operation in the modern world. They are necessary for gathering, organizing, and preserving unprocessed genetic data. A large portion of this data is created electronically and saved straight onto the computer, such as DNA sequence data. Computers are needed for data analysis, which includes deriving biological information from the data using software systems for Phylogenetic reconstruction, and for gene prediction, and structural analysis, and for sequencing databases. Software systems for derivation analysis are frequently employed in the search for human genes to link the underlying genes of genetic diseases. Important gene products can be found and then used to manipulate them using molecular modeling techniques in a computerized search for new functions. The function of computers to solve problems in natural science is known as bioinformatics (will see further about it). Its importance in biotechnology is recognized as demonstrated by its status as an independent Human Genome Project program. The quantity and variety of databases related to molecular biology, genetics, and genomics have been growing quickly due to advancements in data production techniques. Taking an example of Gen Bank, the data maintained by the (NCBI) is rapidly increasing the data-size. The protein sequence data is also rapidly increasing with same rate. So the rapid increase in the data is impossible to store and analyze it with any computer systems. Thus, the computer models and algorithms came to existence. The computer models are now being used to store and manipulate and analyze the biological

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data-base. Computational methods in biotechnology accelerate bio-device design and organic machine engineering, enhancing research across healthcare, agriculture, and environmental sustainability.

2 LITERATURE REVIEW

Computers play a critical role in biotechnology data organization, archiving, and analysis. Biotechnology relies heavily on computers because they simplify intricate procedures, facilitate the analysis of massive datasets, and hasten scientific advancement. The fundamental elements of a bioinformatics are shown in 100.1.

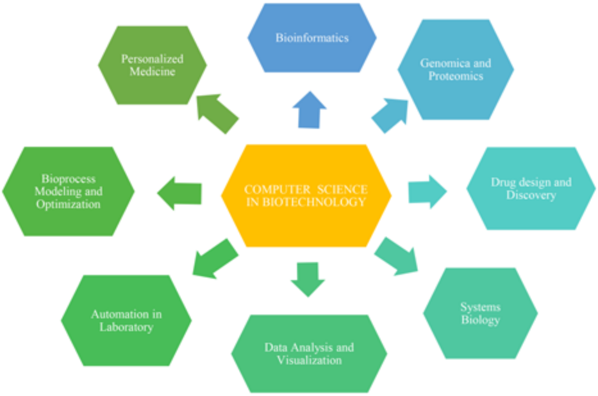
Bioinformatics
Personalized Medicine
Genomica and Proteomics
Bioprocess Modeling and Optimization
COMPUTER SCIENCE IN BIOTECHNOLOGY
Drug design and Discovery
Automation in Laboratory
Data Analysis and Visualization
Systems Biology

Figure 1. Fundamental elements of a bioinformatics.

Computers are primarily used for the following purposes in the field of biotechnology:

2.1 *Bioinformatics*

The scientific field of bioinformatics is the result of the integration of information technology, computer science, and biology into one discipline. Enabling the invention of novel biological approaches and setting up a global viewpoint from which merging principles in biology can be recognized are the eventual objective of field.

2.2 *Genomics and proteomics*

High-performance computing is essential for processing large-scale genomic and proteomics data. Computational methods are used for genome assembly, annotation, and comparative genomics, as well as for protein structure prediction and analysis. While proteomics usually refers to the large-scale trial study of proteins and proteomes, mass spectrometry and protein purification are frequently mentioned specifically.

2.3 *Drug design and discover*

Computational techniques are used in design and finding of new drugs. Virtual screening, molecular modeling, and simulation studies help researchers predict the interactions between drugs and biological targets, leading to the development of more effective and targeted therapeutics. The process of finding new drugs entails identifying screening hits, optimizing medicinal chemistry, and increasing the similarity, selectivity, efficiency, strength, metabolic constancy, oral bioavailability, and decline of side effects. Drug improvement can be continued after a complex satisfies each of these criteria has been established.

2.4 *Systems biology*

By integrating complex biological data from multiple sources, computers make it easier to build comprehensive models that allow for the holistic study of biological systems. The dynamics of biological networks and pathways can be better understood with the use of systems biology techniques. In biomedical research, systems biology is a method for piecing together the various parts to understand the bigger picture, whether it is at the stage of the living being, tissue, or cell.

2.5 *Data analysis and visualization*

Experimental data produced in biotechnological research is analyzed and visualized using computers. Researchers can find patterns, trends, and correlations in datasets by using sophisticated data analysis tools and software, which helps with the interpretation of experimental results.

2.6 *Automation in the laboratory*

With the integration of computers into instruments and equipment, a variety of tasks, including handling samples, and gathering and analyzing data, can be automated. The automation of experimental procedures enhances their efficiency, accuracy, and reproducibility.

2.7 *Bioprocess modeling and optimization*

Bioprocesses including fermentation, bioreactor operations, and metabolic engineering are modeled and optimized by computers. Biological system behavior can be predicted with the use of computational models, which can also be used to optimize process parameters for higher product yield and quality.

2.8 *Personalized medicine*

In personalized medicine, genomic data and other patient-specific data are analyzed using computational tools to customize dealing plans based on each patient's unique inherited outline. More accurate and successful healthcare interventions are possible with this method.

3 METHODOLOGY

This part will give you detailed information about different computer algorithms and techniques used in biotechnology.

3.1 *Bioinformatics*

Study of DNA, RNA and protein sequences have been made in computational biology and bioinformatics, biological data-base purposely. Paulien Hogeweg and Ben Hesper are the biologists who came up with the definition of the word "bioinformatics" in 1970. It can also be said that bioinformatics is an application of tools of computation and technology for retaining, storing, and interpreting biological data. Biological literature text mining and from gene creation to biological ontologies and organizing biological data are two aspects of bioinformatics. Decoded DNA sequences of thousands of living-beings have been formed since the 1970s, sequencing of the bacteriophage Phage Π-X174[22]. This sequence data is used to analyze and identify genes encoding proteins, RNA genes, structural motifs, regulatory sequences, and repetitive sequences are identified by analyzing this sequence data. Gene comparisons within or between species can reveal relationships between species or similarities in the functions of proteins. Manual DNA sequence analysis has long since become impractical due to the increasing volume of data. Determining the nucleotide sequence in an organism's DNA is a necessary step in the sequencing of its genome. There are various approaches available, and the process has changed over time. The general steps in genome sequencing are as follows and shown in Figure 2:

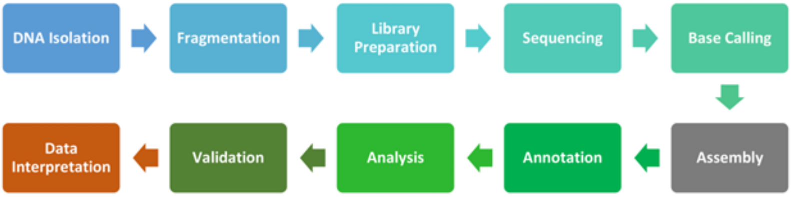

Figure 2. Sequencing genomes steps.

3.1.1 *DNA isolation*

DNA isolation involves the collection of a sample containing DNA of interest and to isolate that sample using various extraction techniques.

3.1.2 *Fragmentation*

The isolated DNA is then fragmented into small or micro pieces mechanically or enzymatically.

3.1.3 *Library preparation*

After the fragmentation of isolated DNA, the adapters are added to it for the sequencing process. Then the resulting DNA is fragmented with adapters to create a sequencing library.

3.1.4 *Sequencing*

It involves different types of techniques like Sanger sequencing, illumine sequencing and many more. The computer makes it easy by aligning sequencing and assembling them to de novo assembly.

3.1.5 *Base calling*

The raw sequencing data is then converted into a readable format by assigning each signal to a specific nucleotide (A, T, G, or C) using computer software.Here we apply base calling algorithms to interpret the fluorescence signals or other sequencing signals.

3.1.6 *Assembly*

To reconstruct the original DNA sequence, the sequenced fragments are aligned and put together. Using computational techniques, this step could be more difficult for genomes with more complexity.

3.1.7 *Annotation*

Genes, regulatory elements, and other features are located and marked in the assembled genome through annotation.

3.1.8 *Analysis*

To comprehend the genome's structure, functions, and evolutionary relationships, researchers examine the sequenced genome.

The sequenced genome can be compared to other known genomes to perform comparative genomics.

3.1.9 *Validation*

Polymerase chain reaction also known as PCR and Sanger sequencing are two methods used to ensure the accuracy of the sequenced genome.

3.1.10 *Data interpretation*

The last phase entails analyzing the genomic data in light of the particular research question or objective. Genome sequencing using computers has greatly quickened the pace of genomic research and made it possible to analyze huge datasets that would be too difficult to handle by hand.

3.2 *Proteomics*

Proteomics is the complete evaluation and study of the function and proteins to get deep information about the nature of an organism. The computer have a very crucial part in proteomics for the study of protein and their functionality. The field of proteomics involves the large-scale data analysis of proteins where computer tools are used widely for data management and analysis. Following are some fields in which computational tools are used in the field of Proteomics.

3.3 *Drug discovery and analysis*

The process of finding possible candidate pharmaceuticals is known as "drug discovery" in the domains of pharmacology, biotechnology, and medicine. The process of developing novel experimental treatments in the domains of medicine, biotechnology, and pharmacology. Drugs were previously found by chance penicillin, for example or by figuring out what the active component of traditional therapies was. To discover new medications, screening hits are found, medicinal chemistry is used, and those hits are then refined to increase their potency and efficacy, as well as their affinity, selectivity (to reduce the likelihood of side effects), metabolic stability (to extend the half-life), and oral bioavailability. Once a molecule that meets each of these requirements has been identified, drug development can move forward. If it works, clinical trials are created. CADD in the pipeline for drug research and design are shown in Figure 3. CADD-Computational–aided drug design and analysis:

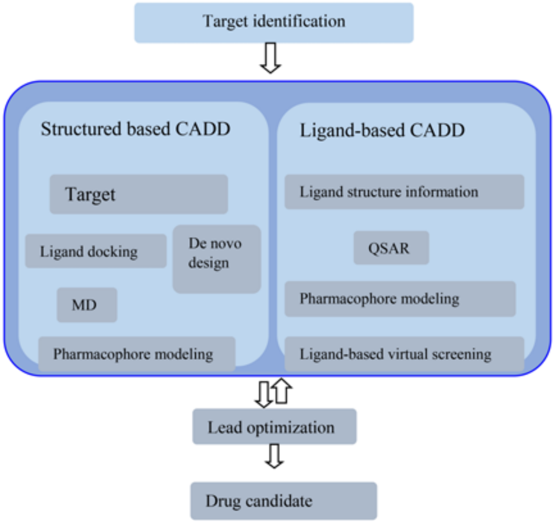

Figure 3. CADD in the pipeline for drug research and design.

A drug needs to be developed to target a specific therapeutic target that has been identified. Depending on the availability of structure information, one employs a ligand-based or a structure-based strategy. A successful CADD campaign can identify multiple lead chemicals. After lead identification, lead optimization and subsequent CADD lead identification are sometimes carried out in many cycles. Drug candidates are identified by testing lead compounds in vivo. Is of two types:

3.3.1 *Structure-based drug design*

The process of creating novel therapeutic compounds by taking into account the target protein's three-dimensional structure is known as "structure-based drug design." The drug's structure can be optimized with the use of computational approaches to improve its binding affinity and specificity.

3.3.2 *Ligand-based drug design*

NThis method creates new compounds with comparable properties by analyzing existing ligands, or molecules that bind to a target. The activity of these engineered compounds is frequently predicted using quantitative techniques.

4 CONCLUSION

The research provides a prime example of the ways in which computer and biotech sciences converge to drive biological discovery, affecting health as well as ecological health and sustainable agriculture. OMICS data is vast while bioinformatics and computational tools facilitate the handling of such voluminous omics data leading to expedited biotechnological processes and deeper insight in complex biological systems. This Trends in Biotechnology Special Issue highlights the essential role of computers in the revitalization of biotechnology, as an enabling medium that helps to acquire and understand data by many sectors.

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A deep dive into the computer virus and its detection algorithms

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ABSTRACT: The purpose of computer viruses is to compromise computer systems by infecting and infiltrating them with harmful software. In the current digital era, this abstract draw attention to the risks that computer viruses pose. Data loss, financial harm, invasions of privacy, and interruptions to vital infrastructure are some of these risks. The significance of cybersecurity measures to lessen these hazards is emphasized in the abstract. The evolution of computer viruses, how they spread, and the possible repercussions of a virus outbreak are also covered. Governments, businesses, and individuals all need to be aware of the risks associated with computer viruses as technology advances in order to safeguard their digital assets and infrastructure.

Keywords: Virus, Threats, Network, Malware, Software, Cybersecurity

1 INTRODUCTION

A computer virus is a malicious software program designed to infect and compromise computer systems. Like its biological analogy, a computer virus can spread and replicate itself, but instead of infecting living creatures, it only affects digital technology. A computer virus can wreak havoc once it has infiltrated a system. Sometimes, these viruses lurk in plain sight among files or programs that seem harmless. A computer virus can do a variety of unwanted actions once it is active, such as erasing or damaging files, obtaining personal data, or providing unauthorized access to a hacker. These activities could lead to serious disruptions in computer operations, data loss, and unstable systems. Because their concealment measures, like polymorphism and encryption, use difficult-to-detect methods, antivirus software and regular system upgrades are essential for protection.

2 WHAT IS COMPUTER VIRUS

As with its biological counterpart, a computer virus is a program that replicates itself and has the ability to infect one computer system and spread to others. It is designed to do evil things, often without the user's awareness or agreement. Various methods exist for viruses to infiltrate a computer, such as through infected files, email attachments, and downloads from questionable sources [1]. Two of a computer virus's primary objectives are to spread itself and deliver its intended payload. Viruses disguise themselves in normal applications or files by embedding their code there in order to do this. The code of a virus is also active when an infected application or file is launched, giving the virus the ability to infect further files or systems. Because of this method, the virus spreads widely and often goes undetected until it begins to create problems. Nevertheless, more dangerous infections may result in dire outcomes like:

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2.1 *Data corruption*

Certain viruses are designed to alter or erase data and files from an infected computer. This could result in the loss of crucial data, such as business information, images, and private documents [1].

2.2 *System instability*

A computer system may crash, freeze, or stop responding as a result of viruses interfering with its regular operation. This could lead to user annoyance and decreased productivity.

2.3 *Unauthorized access*

Infected systems may have backdoors opened by some viruses, which allow hackers to access data without authority. Spying, data theft, or more system breaches could arise from this. [1]

2.4 *Botnet formation*

A botnet is a collection of hacked devices that is created when certain infections make infected computers into zombies. These botnets can be remotely controlled by cybercriminals to conduct coordinated attacks like distributed denial-of-service (DDoS) attacks.

3 STRUCTURE OF COMPUTER VIRUS

Malicious software, sometimes known as computer viruses, are programs created with the intention of doing harm to other computers by self-replicating and spreading to other systems. Although a computer virus's structure might change, it often consists of multiple parts. [2,3]

- Infection Mechanism (Propagation Code)
- Triggering Mechanism
- Payload (Malicious Code)
- Concealment (Encryption/Obfuscation)
- Stealth: (Polymorphic Code)
- Dropper
- Rootkit (Code to Hide Itself)
- Communication (Code for Communication)
- Evasion (Anti-Antivirus Techniques)

4 HISTORY OF COMPUTER VIRUSES

Computer viruses have a long history that begins in the early years of computing. Here is a quick summary of the significant turning points in the development of computer viruses:

4.1 *Early research, 1940s–1970s*

Although the idea of self-replicating computer programs was first explored in the 1940s and 1950s, these early studies were mostly of an academic nature. Fred Cohen first used the phrase "computer virus" in his doctoral thesis in 1983, although self-replicating code had been studied before.

4.2 *Early in the 1970s, the Creeper virus*

One of the most ancient computer viruses .is frequently regarded as the Creeper virus. Bob Thomas designed it in the early 1970s, and it attacked machines that were connected to the ARPANET at the time. The message “I’m the creeper, catch me if you can!” was shown by the malware.

4.3 *1982 The Elk cloner*

One of the earliest computer viruses to proliferate in the wild was the Elk Cloner. Through contaminated floppy disks, it infected Apple II computers. Every fifty boots would result in a poem being shown on the screen.

4.4 *1986 The brain virus*

The Brain virus was thought to be the original PC virus. It was made by two brothers from Pakistan and disseminated by contaminated floppy disks. A message purporting to be a legal notification from the virus’s creators was shown by the infection.

4.5 *1988 The Morris Worm*

One of the earliest worms to become well-known was the Morris Worm, which Robert Tappan Morris invented. It caused extensive disruption as it propagated throughout the early internet.

4.6 *The nineties: Spread and Notoriety*

The quantity and sophistication of computer worms and viruses significantly increased in the 1990s. The ILOVEYOU worm, the Melissa virus, and the Michelangelo virus are a few famous instances.

4.7 *Evolution of malware and cybercrime, 2000s-Present*

Computer viruses developed alongside the internet and other technologies. The use of viruses for financial gain in identity theft, ransomware, and bank fraud is how malware programmers first got their start. A few prominent malware cases that made news in the 2000s and 2010s are Conifer, Stuxnet, and the WannaCry ransomware [3].

4.8 *Threats that are advanced persistent (APTs)*

Advanced persistent threats (APTs) are a type of cyberattack in which highly proficient and driven attackers use malware and viruses to infiltrate particular targets, like corporations and government institutions. One famous APT is the Stuxnet worm.

4.9 *Current threat environment*

The threat landscape that the globe faces today is ever-changing and includes a wide range of malware, such as ransomware, Trojan horses, and botnets. Cybersecurity measures are still being modified to counter these attacks and the number of virus attacks as shown in Figure 1.

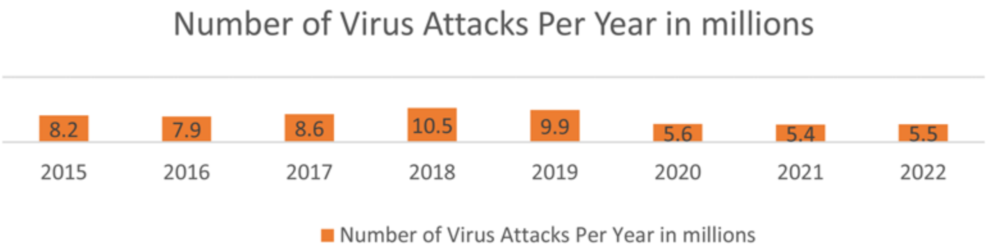

Figure 1. Number of virus attacks.

5 CURRENT THREAT ENVIRONMENT

The modern threat landscape is ever-changing and comprises a wide range of malware varieties, such as ransomware, worms, Trojan horses, ransomware, and botnets, in addition to more conventional computer infections [4]. The Internet of Things (IoT), linked device proliferation, and the internet's quick growth have all created new channels for virus transmission. Unpatched software, human mistake that fraudsters easily take advantage of, and poor security procedures are major obstacles in the fight against malware and computer viruses. To tackle this constantly changing threat landscape, cybersecurity professionals and institutions utilize a multipronged strategy that includes [5]:

- Antivirus Software
- Network
- Intrusion Detection Systems (IDS)
- Proactive Threat Hunting
- User education
- Security Best Practices

6 STAGES OF COMPUTER VIRUSES

When spreading, computer viruses go through a set of steps. These phases describe how a virus propagates and carries out its nefarious deeds on a computer system. Identification and prevention of viral infections depend on an understanding of these stages. Here are the typical stages of a computer virus infection:

- Entry
- Execution
- Replication
- Concealment
- Payload Activation
- Spread
- Communication and Control

7 DETECTION OF COMPUTER VIRUSES

One essential component of cybersecurity is the detection of computer viruses. To detect and lessen the effects of viruses, several strategies and tactics are employed. An outline of popular virus detection techniques is provided here [6,10]:

- Antivirus Software
- Heuristic Analysis.

- Behavioral Analysis
- Sandboxing
- Anomaly Detection
- Network Intrusion Detection Systems (NIDS)
- Email Scanning
- File Integrity Monitoring
- Rootkit Detection
- Machine Learning and AI
- Community and Threat Intelligence

8 ALGORITHMS FOR DETECTINNG VIRUSES

Numerous algorithms and methods are used in the detection of malware and computer viruses. Antivirus software and cybersecurity tools use these algorithms to recognize and reduce the risk of harmful software. The following are some popular formulas and techniques for identifying computer viruses [7]. Comparison of Virus Detection Techniques is shown in Table 1.

(a) Signature-Based Detection
(b) Heuristic Analysis
(c) Behavior-Based Detection
(d) Sandboxing
(e) Anomaly identification
(f) Machine Learning and AI
(g) YARA Rules
(h) Fuzzy Hashing
(i) Machine Code Analysis
(j) Entropy Analysis
(k) Memory Analysis
(l) Network Traffic Analysis

Table 1. Comparison of virus detection techniques [6].

Methods/ Parameter	Signature Based virus Detection	Anomaly Based Detection	Code Emulation
Strength	Efficient	New malware	Encrypted viruses
Limitation	New malware	Unproven	Complex
Cost	Low	Costly to implement	Costly to implement
Accuracy	More if database is updated	Less	More

9 DETECTION

9.1 *Signature based detection*

In cybersecurity, signature-based detection is a technique used to find known dangerous patterns, such viral signatures. The concept is to use a database known malware signatures to check a file's or codes digital signature against. A condensed formula for signature-based detection is as follows [9].

Detection:

- True Positive (TP), if signature matches
- False Positive (FP), if signature does not match (false alarm)
- False Negative (FN), if no signature matches (missed detection)
- True Negative (TN), if no signature match (correctly identified as non-malicious.

Key concepts:

- True Positive (TP): Based on the file's signature, the system correctly classifies the file as malicious.
- False Positive (FP): When a file is not harmful, the system mistakenly classifies it as such.
- False Negative (FN): When a file is malicious, the system does not recognize it as such.
- True Negative (TN): The file is accurately identified as non-malicious by the system.

The cryptographic hash or unique identifier (signature) of a file is actually compared to hashes or signatures in a database of known malware signatures as part of the detection procedure. The file is marked as possibly harmful if a match is found [8].

9.2 *Heuristic analysis*

In the context of cybersecurity, heuristic analysis refers to the process of identifying patterns or behaviors that can point to the existence of malware by applying established rules or heuristics. This is a condensed heuristic analysis formula:

Analysis:

- Malicious (M), if heuristic rules indicate malicious behavior
- Non-Malicious (NM), if heuristic rules do not indicate malicious behavior

Key concepts:

- Malicious (M): The system marks the examined code or behavior as displaying traits that correspond to preset heuristic rules linked to malware.
- Non-harmful (NM): The system concludes that the behavior or code under analysis does not adhere to heuristics that point to harmful activity.

Developing a set of guidelines or rules based on known malware characteristics is known as heuristic analysis. These guidelines might contain coding, behavioral, or action patterns that are frequently connected to dangerous software. The system then uses these heuristics to assess the possible maliciousness of files or activities by analyzing them. Heuristic analysis in the real world is more intricate and may combine several different heuristic approaches. Here are a few more things to reflect about:

- Rule-Based Heuristics: Specifying clear rules that mirror typical malware characteristics, like specific code snippets, file actions, or network activity.
- Dynamic heuristics: Examining how code behaves during runtime and pointing out departures from typical patterns. Heuristics for generic signatures: Recognizing patterns that point to potentially harmful activity but are not unique to a specific malware version.
- Behavioral Heuristics: Examining how programs or processes behave in order to see if they follow patterns that are known to be dangerous.
- Learning Heuristics: Using machine learning methods to gradually increase heuristics' efficacy.

10 CONCLUSION

The hazards of computer viruses are significant and can have far-reaching consequences for individuals, businesses, and even governments. Here's a concise conclusion regarding these hazards:

- Data Loss
- Financial Loss
- Privacy Breach
- Disruption of Services
- Network Intrusion
- Reputation Damage
- Spreading Malware
- Legal Consequences
- Resource Consumption
- Global Threats

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Advancements and challenges in federated learning: A survey

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ABSTRACT: The most significant advancement in this field can be attributed to federated learning (FL). Such a technique permits the classifier to be trained at different locations with a variation of privacy layers featured. It delves into basic Fuzzy Logic ideas viz., its concepts, framework basics, and clustering by data distribution patterns. Various issues such as privacy and security problems, particular needs that result from heterogeneity of data, and security attacks are highlighted broadly in addition with the solutions and methods presented like differential privacy and homomorphic encryption [2]. Besides that, the paper also executes various FL platforms from the standpoint of healthcare, internet of things, autonomous vehicles, recommendation system, and edge computing in order to verify its capacity to redesign it all together in the centralized environment. The emerging- martial field of AI in Florida is full of potential paths to innovation concurrently with data and privacy regulations.

Keywords: Federated Learning, Machine Learning, Data Privacy, Decentralized Learning, Privacy Protection, Security Challenges, Heterogeneity, Applications

1 INTRODUCTION

Federated Learning (FL) empowers clients to keep their data private and locally processed, by de-centralizing model training. Introduced by McMahan *et al.* FL (2017) the heterogeneity of datasets and the limitations of resources available for devices such as smartphones and Internet of Things (IoT) nodes, are accommodated in FL. It is critical to fields such as defense, telecommunications, IoT, and Pharmaceuticals for its data privacy and efficiency gains since it allows collaborative ML models to be built while keeping privacy.

2 LITERATURE SURVEY

From the paper written by Jie Wen *et al.* (2023) which was presented at "International Journal of Machine Learning and Cybernetics" gives the insights of diverse applications of this field. It also handled the challenges such as data differences, communication efficiency and privacy concerns and explored the real-world applications in the sectors of healthcare, finance, IOT etc. McMahan *et al.* (2017) and Li *et al.* (2022) mainly focused on the necessity of advanced optimization techniques and privacy preserving techniques through streamlined learning communication, safeguarding and model debugging against infringement of privacy. Research by Yi *et al.* (2014) and Giacomelli *et al.* (2018) focused on encryption methods. The studies from Yang *et al.* (2019),Wang *et al.* (2022) and Hemalatha and Rajkumar

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(2021) given FL's flexibility in handling various tasks such as secure computations, task scheduling, sentiment analysis and age estimation.

3 BASIC KNOWLEDGE OF FEDERATED LEARNING

One effective method for training machine learning algorithms is federated learning, which makes use of distributed, locally-based datasets. In this paradigm, participants—such as smartphones or IoT devices—train their own local models and periodically share model parameters to create a global model. Unlike traditional distributed learning, federated learning accommodates diverse datasets and resource-constrained clients. Assuming N is the number of participants, the fundamental idea of FL is to combine the data from {P_1, P2, P3 … , PN} in order to train the global model. For Model training Msum with V_{sum} performance, to collect data and use the total data set as $P = P_1 \cup P_2 \cup \ldots \cup P_N$. As a learning framework, FL ensures that no participant's private data is exposed to others when trained with common model M_{fed} with V_{fed} performance. If we assume that Δ is not negative, we can write the performance loss of the FL model as

$$\left|V_{fed} - V_{sum}\right| < \in \tag{1}$$

Learning FL involves loss function minimization that is determined for weighted aggregation approach for each client. And its aim is to reach one with the lowest objective function.

$$minf(w) = \sum_{k=1}^{N} \left(\frac{n_k}{n}\right) F_k(w) \tag{2}$$

In this context, nk denotes quantity on the kβth client, N stands for the total number of clients and Fk(w) – local objective function of k^{2}th client's. Learned global federated model and the centrally trained model may exhibit a small degree of performance variance thanks to Federated Learning (FL) [5]. With each successful cycle of global federated training, the global model's efficiency grows, and it will ultimately match that of the centralized model.

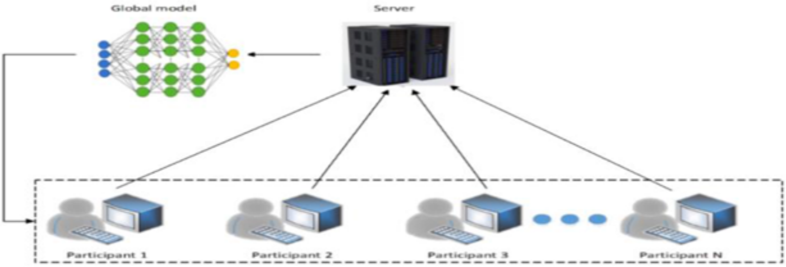

Figure 1. Fundamental architecture of FL.

Figure 1 depicts the architecture for federated learning. It all starts with model distribution, in which every client gets a shared baseline model from the server. Afterwards, during local training, each client uses their own data to train their model until they reach convergence. Following this, the client encodes the model boundaries before returning them to the server during the upload process. After then, in the Aggregation and Update stage, the server refreshes the worldwide model for the following preparation iteration by aggregating the uploaded parameters or gradients using the Federated Learning (FL) [6] method. This procedure repeatedly communicates back and forth between the client and server in an ongoing fashion until the federated model on a global scale converges.

4 FEDERATED LEARNING (FL) CLASSIFICATIONS

There are three distinct kinds of Federated Learning (FL) that are distinguished by the patterns of data distribution.

4.1 *Horizontal federated learning (HFL)*

In this approach, multiple clients collaborate to train the model and ensuring that their data be decentralized [7].

4.2 *Vertical federated learning (VFL)*

Here, the focus is on collaborative training across different features or attributes of the data.

4.3 *Federated transfer learning (FTL)*

Improving a target model's performance in a federated context by transferring information from a pre-trained model falls under this category.

5 PRIVACY AND SECURITY CHALLENGES IN FEDERATED LEARNING

One of the intriguing directions which is very important in machine learning is federated learning, is where the central body or server does not require data to be transferred when training model on distributed devices. Conversely, it causes many controversies within privacy [10] and security. However, confidentiality of data arises as a real issue, where model upgrade or gradients could be exposed by hackers to infer some private information. The methods like different privacy and data security aggregation technologies are applied to tackle this problem. In addition, poisoning by adversarial models, where the long-term learning can be corrupted through the introduction of the data with malicious intent, is among the primary concerns that demand a deployment of strong aggregation and anomaly detection mechanisms. Membership inference attacks, when the attacker infers data usage just from the outputs of the models, is averted by the use of erasures like differential privacy and competitive training. Likewise, the model inversion attack attempt to guess the individual information just by updating model, but this implication can be stopped by using techniques such as differential privacy and regularization.

5.1 *Privacy protection techniques in federated learning*

Privacy preserving in America is a technique which has its application in federated learning. It is aimed to protect individual user data at all stages of model training, i.e., during services deployment/updates. This method includes the addition of noise to the gradients taken at local level before they are sent to the central node for aggregation. By doing so, it will be able to prevent an attacker from retrieving specific user information, even if the attacker does a data analysis about gradient summations. Differential privacy ensures above the mathematical proof of privacy assurance [9] through the addition of the controlled amount of noise to the gradients. That way the system is able to extract relevant insights from various devices, no matter their security integrity to each user.

5.1.1 *Differential privacy noise addition*

In Federated Learning, before transmitting gradients from local devices to the central server, noise is added to ensure privacy. From the probability distribution such as Laplace or Gaussian-the noise is drawn, and its scale depends on the parameter ϵ.

5.1.2 *Budget of privacy loss*

Privacy parameter ϵ quantifies the level of privacy protection provided by differential privacy. It represents the maximum allowable privacy loss due to the participation of a single individual in the learning process.

5.2 *Homomorphic encryption (HE)*

The breakthrough could be achieved if a brand new technology referred to as homomorphic encryption (a variant of cryptography) [11] is used. In other words, you can perform these operations without having to "decrypt" the data first; the data simply comes out as encrypted results. Such functionality is particularly important for systems where data privacy takes a center stage such as the federated learning approach. The participant devices used homomorphic encryption on the data shared among them implements the encryption for the protection of confidential information.

Homomorphic encryption encapsulates the many schemes each having different capacities and efficient ways. Process of Federated Learning as shown in Figure 2.

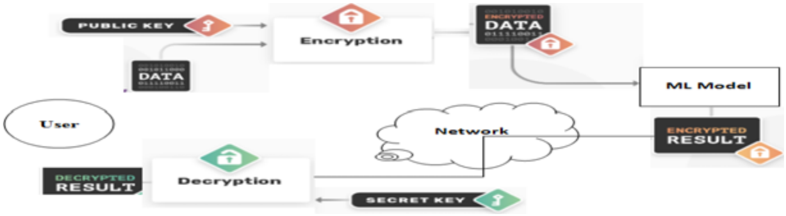

Figure 2. Process of federated learning.

6 FEDERATED LEARNING-SECURITY ATTACKS AND IT'S SOLUTIONS

In federated learning (FL), various security threats endanger the integrity [11], confidentiality, and privacy of the data and models involved.

6.1 *Model poisoning attacks*

Global model performance is adversely affected by injecting the malicious data. Robust anomaly detection mechanisms can filter out malicious updates during model aggregation. Regularization techniques also mitigate the impact of poisoned data.

6.2 *Data poisoning attacks*

Adversaries manipulate local training datasets to affect the global model's performance. Implement data validation and authentication mechanisms to ensure training data integrity. Differential privacy techniques limit the influence of individual data samples.

6.3 *Model inversion attacks*

Sensitive information is inferred from model updates or outputs, compromising user privacy. Apply differential privacy mechanisms to limit information leakage. Regularization and adversarial training hinder adversaries from extracting sensitive information.

6.4 *Membership inference attacks*

Attackers deduce whether specific data samples were used in training by analyzing model outputs. Employ differential privacy mechanisms to obscure data presence. Adversarial training complicates attackers' attempts to infer membership.

6.5 *Eavesdropping and data leakage*

Unauthorized entities intercept sensitive data or model updates. Use encryption protocols to secure communication channels. Secure multiparty computation ensures computations on encrypted data.

6.6 *Model extraction attacks*

Adversaries attempt to extract the global model's parameters or architecture. Model watermarking embeds identifiers into the global model. Federated averaging secures model updates, preventing adversaries from reconstructing the global model.

7 HETEROGENEITY CHALLENGE IN FEDERATED LEARNING

In the classic version of Federated Learning (FL), the parameters or gradients selected on the client side of the model are usually amalgamated into one globally applicable model. However, during the aggregation process, researchers have increasingly recognized practical challenges stemming from federated heterogeneity. These challenges include data heterogeneity issues arising from non-identically distributed (non-IID) data across clients, as well as model heterogeneity issues resulting from varying client model sizes due to differences in device resources and personalized tasks.

The heterogeneity challenge in federated learning (FL) pertains to the diverse nature of devices, data distributions, and computational capabilities within the federated network. This diversity poses several hurdles that must be overcome to achieve effective and efficient model training.

7.1 *Discrepancies in data distribution*

One of the most problems is that data collected from different sources differ significantly, not only in terms of volume, quality but also diversity, which which can lead to biased models or poor performance in terms of generalization across the whole federated network. Apply methods of data organization, augmentation, and adaptive learning algorithms in order to alleviate the effects of different data distributions.

7.2 *Challenges in communication and computation*

The next challenge could be since the devices in FL vary in terms of communication bandwidth, computational power, and energy constraints, these differences may hinder the efficiency and convergence of the learning process. Open up avenues of work on such areas as communications efficiency algorithms and data cooperation strategies allowing for diverse machine capabilities. Technologies such as hierarchical aggregation, adaptive compression and selective participation can reduce the toxicity of communication and increase the speed of convergence in the chaos of heterogeneous environments.

7.3 *Multiple model architectures*

The devices using a diversity in model architecture, objectives, and technique of training make the process of merging updates from model a difficult task. Unify device models so as to specify their functions across them to ensure the conformity in updates. Furthermore, multi-model integration approaches such as model distillation and ensemble learning can be used to combine different models and therefore improve the accuracy of predictions.

7.4 *Private features and security composition*

There are various levels of privacy and security measures in devices and FL can be breached and attackable as a result. Be confident deploying methods that properly guard privacy of users, like secure aggregation, differential privacy and encryption.

8 FEDERATED LEARNING APPLICATIONS

Scalability, privacy, and the requirement for the collaboration of several sites are delicate attributes, and they are a bit challenging to deal with in many areas. This is where Federated Learning (FL) is used as it provides a solution. Its uses include,

8.1 *Federated learning in healthcare*

The workshops will be interactive in nature, by incorporating visually stunning natural landscapes and interactive activities to make the concepts easily understood. Health care systems are confronted with the problem which is usual there are many subdivisions and the data are sprawled and those solid centralized breaks success of training down and then it compounds the privacy issues. FL takes care of such health concerns by processing the model training right off the local data collected from clinics, hospitals and wearable devices while data sharing is not required. By implementing FL, model updates can be centrally aggregated and not individual patient data. This is a powerful tool that can be used for disease prediction, treatment recommendations, and drug discovery.

8.2 *Federated learning in IOT*

Interoperability of IoT is another factor that needs to be addressed through Federated Learning, since the deep model preparation needs to be done on scattered – IoT – devices, while preserving information security and reducing communication overhead. IoT contexts generally abound in many devices types which ranges from the non-functional or small sensors such as those in homes to the large types where industrial systems reside. The conventional centralized method for training models does not work as it is not possible to manage the diverse and many data sources at the same time, also there are concerns regarding data privacy and the availability of network bandwidth. These issues are addressed by FL, and web-enabled devices are enabled to train ML.

8.3 *Federated learning in autonomous vehicles*

With privacy protection in mind, FL remains a well-presented option for coordinated model learning across powerful, separate as well as weak data sources. In AV (autonomous vehicle [13]) environments, the amount of data is considerable, correlated with variety of sensors and systems that are important for tasks such as object detection and decision making. Although, centralized training with conventional methods does not emancipate one from these issues of huge volumes of protected data. By using this distributed intelligence technique, cybersecurity is maintained at the same time, resulting in the reduction of constant data transmission making the autonomous driving systems in real time. Using FL helps vehicles to acquire knowledge through cooperation in a fleet, which gives them efficient predictions, adaptability, and safety as they approach a variety of driving situations.

8.4 *Federal learning in recommendation systems*

Federated Learning (FL) facilitates collaborative model training across diverse data sources while ensuring robust user privacy protection, crucial for recommendation systems in e-commerce, entertainment, and social media.

8.5 *Federated learning in edge computing*

Federated Learning enhances edge computing by enabling collaborative model training while preserving privacy and minimizing communication overhead.

9 CONCLUSION

In short words, all features of FL empower distributed systems in a way that: 1) they do not violate data privacy; 2) they do not require all the data, but only the most necessary; and 3) they grant the right to the access of the data. Through this segment of the course, the learners will be cooperating to work from home and protect the individual data privacy. Though, introducing FL may not be a feasible solution for all types of applications as there are certain difficulties of dealing with data heterogeneity in multi-device settings and protecting the privacy and data security.

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An automated computerized method for the detection of fire using novel deep learning based method

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ABSTRACT: The increasing prevalence of fire incidents in various environments underscores the critical need for efficient and accurate system to detect fire and reduce the harms due to the said. In a proposed method, a novel approach to detect and classify the fire scene using custom designed deep neural networks with a remarkable accuracy exceeding 99%. The proposed custom network model is trained on a widely proven dataset comprising annotated images of fire and non-fire class to ensure resilience and generalization Our methodology involves the extraction of high-level features from input images through multiple convolutional layers, capturing intricate spatial hierarchies essential for discriminating fire scenes. The dataset was meticulously curates to include diverse fire scenarios, varying environmental conditions, and non-fire instances to create a comprehensive learning environment for CNN. The training process involves fine-tuning the parameters to optimize the network performance on the said task.

Keywords: Fire Detection, Deep Learning, Cnns, Image Classification, Fire Scene Analysis, Diverse Datasets, High Accuracy (99%).

1 INTRODUCTION

It's critical to collaborate with intervention to detect fire or smoke at the first signs of danger in order to prevent severe injury. Various estimations based on pictures and videos have already been developed to overcome the shortcomings of the aforementioned methodologies. Chen with his colleagues [1] proposed a smoke recognition process that takes video monitoring into account. Toreyin *et al.* [2] have presented an alternative methodology that perceives infinite fire by combining edge darkening, sparkle features, development and assortment sign features. Mueller *et al.* developed an optical stream technique based on video [3], which is essentially an ideal mass vehicle model that uses stream heading and size properties to distinguish between fire and non-fire development. Bugarovich and his team [4] developed a PC vision based method which uses GIS-based extended reality to evaluate the fire's component sections. To detect fire in images of woodlands, Zhang *et al.* [5] suggested using two connected significant CNNs. Importantly, in this system, one overall picture classifier attempts to classify the entire image; subsequently, one more classifier is used in the subsequent part to identify the region of interest of the image where the fire is present. Tao [6] developed a substantial CNN model for smoke acknowledgment, a pretrained network model called AlexNet [7] was used for this purpose. Yin and team mates [8] promoted a custom CNN model for picture smoke disclosure, despite the fact that those methods make use of already-existing significant learning procedures for fire or picture ID.

2 LITERATURE SURVEY

For a quick plan, Fake Mind Association-based techniques, as described in paper [9], use Levenberg-Maraquardt planning estimation. The accuracy of the computation varied between 61% and 92%. In [10], it is claimed that existing hardware-based systems are imprecise and prone to false problems, which means they are likely to misidentify real fires. There was a significant CNN method to flame disclosure and limit in works [11] and [12]. The obtained precision decreased from 97% to 90% in these two articles. This ineffective work approach is encouraged by motorized include planning [13]–[14], which eliminates accommodating and important elements from data with a construction that can be used for any problem. The author of article [15]

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suggested that craftsmanship is important independent of classifiers and that deep learning is approaching. In paper [16], the efficiency of deep neural network for the detection of fire and smoke scene in a real time. A comparison between RetinaNet and Faster R-CNN was made in article [17]. The author states that the methods used in study [18] include Kalman filters, Hidden Markov Models (HMM), Support Vector Machines (SVM), and other related approaches. occasionally employed to analyze components such as surface, wavelets, tone, or smoke movement.

3 PROPOSED METHODOLOGY

The proposed strategy is displayed as a stream outline in Figure 1. The following is a clarification of each move toward the stream diagram:

(A) Data organization
(B) Preprocessing of data
(C) Data splitting
(D) CNN development for classification purpose

The CNN animated by the visual dealing with arrangement of the human brain and are proper for getting mind boggling models and features inside pictures [19]-[20]. As the association's significance constructs, these features combined to shape visual parts, followed by classification. Totally related layers process the isolated features and make the last request decisions [21]-[25]. The preparation interaction incorporates forward spread, where the information goes through the organization's layers, and in reverse engendering, where the organization's expectations are contrasted with the genuine names, and the organization's boundaries are acclimated to limit the forecast mistake [26]-[27].

(E) Proposed CNN

The proposed CNN consists of the following layers:

1. Input Layer
2. Convolutional Layers
3. Max Pooling Layers
4. Fully Connected Layer
5. Softmax and Classification Layers
6. Training Options: The optimal number of preparation epoch is 20, and the learning is performed at a learning rate of 0.05. The 'Validation Frequency' is set to '5'.

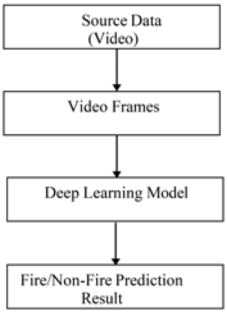

Figure 1. Workflow diagram of the proposed methodology.

4 RESULT AND DISCUSSION

The suggested approach uses CNN to group the fire images from the scene. The purpose of the custom CNN is to perform the suggested computation. Figure 2 shows the plot of training and testing accuracy and Figure 3 shows the plot of training versus testing loss. The suggested strategy's exhibition boundaries are explicitness (spe), responsiveness (sen), and accuracy (acc). The 999 JPEG images in the dataset, which is publicly available at [30], depict both fire and non-fire scenes. Table 1 shows the disarray network of the characterization using the suggested technique.

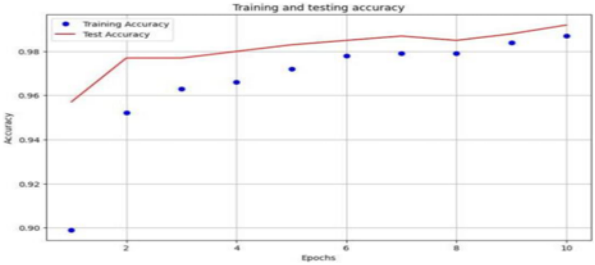

Figure 2. Plot of training vs testing accuracy.

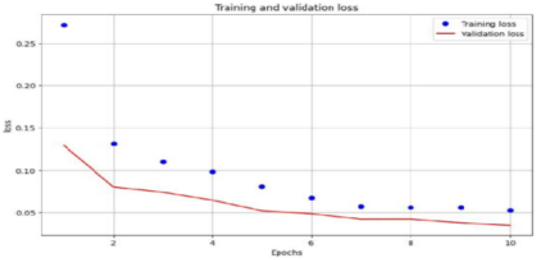

Figure 3. Plot of training vs testing loss.

Table 1. Matrix showing the classification results of Fire and non-fire scenes.

True Class	Predicted Class	
	Fire Scene	Non-Fire Scene
Fire images	747	08
Non-Fire images	03	241

Table 2. Metric of the proposed system.

Class/Parameter	Fire	Non-Fire	Average (%)
Accuracy (Acc)	99.02%	99.02%	99.02%
Sensitivity (Sen)	98.90%	98.30%	98.60%
Specificity (Spe)	98.30%	98.90%	98.60%

5 CONCLUSION

In conclusion, this manuscript proposed custom deep neural networks for the classification of fire and non-fire scenes in images. The results of the proposed custom CNN has demonstrated remarkable success, with a remarkable accuracy rate of up to 99.02%. This article has underscored the advantages of deep learning techniques, particularly CNNs, in addressing the critical need for accurate and timely fire detection. The consistent high accuracy observed in both training and validation sets highlights the robustness of our model in learning intricate features associated with fire scenes across diverse environments. The incorporation of transfer learning has proven instrumental in accelerating convergence, enabling the model to discern nuanced patterns indicative of fire incidents. Furthermore, the meticulous curation of a comprehensive dataset, encompassing various fire scenarios and environmental conditions, has contributed to the model's ability to generalize well beyond the training set. Real-world testing scenarios have validated the practical applicability of our CNN-based approach, showcasing its efficacy in diverse and challenging settings. The implications of this research are far-reaching, with potential applications in surveillance systems, smart building technologies, and public safety infrastructure. The high classification accuracy achieved by proposed method offers an advantageous outcomes fire scene classification, minimizing response times and mitigating potential risks associated with fire incidents.

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An efficient resource allocation using Cuckoo search algorithm

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ABSTRACT: Cloud computing has revolutionized computing paradigms by providing scalable resources accessible over the internet, To maximise efficiency and cut expenses, efficient resource allocation and job scheduling are necessary. This study explores the application of the Cuckoo Search Algorithm (CSA) to enhance virtual machine (VM) placement in cloud data centers. The project involves designing a simulation framework to model cloud data centers and workloads, integrating CSA into task scheduling processes, and evaluating performance depending on important variables such as energy efficiency, resource use, and job completion time. Through rigorous experimentation, the study demonstrates that CSA-based allocation significantly improves resource utilization and responsiveness to workload fluctuations compared to traditional methods. The algorithm's efficiency in exploring solution spaces and adapting to dynamic environments contributes to enhanced performance and cost-effectiveness in cloud environments. These findings suggest that CSA holds promise for optimizing resource allocation in dynamic cloud environments, advancing task scheduling techniques, improving service quality, and reducing operational costs. Future research could focus on refining CSA parameters across diverse cloud scenarios, integrating with machine learning techniques for enhanced predictive capabilities and real-time adaptation to evolving workload demands.

Keywords: Cloud Computing, Resource Allocation, Cuckoo Search Algorithm, Task Scheduling, Optimization

1 INTRODUCTION

Cloud computing has emerged as a paradigm-shifting invention in recent years, advertising adaptable and on-demand get to a pool of computing assets over the web. With its broad selection over different segments, optimizing asset utilization and errand planning in cloud situations has ended up fundamental for improving execution and lessening operational costs. In this setting, effective virtual machine (VM) situation plays a basic part in accomplishing ideal asset allotment and workload management. Cloud computing is the modern wave in conveyed computing that gives equipment framework and computer program applications as administrations. These administrations can at that point be secured on the premise of an SLA, which incorporates the required QoS, as a utility based on real utilization. Whereas there are various papers on the planning issue for classical dispersed frameworks, such as Frameworks, as it were a few works examine the issues for HPC Clouds. The multi-objective angle of cloud planning is especially intense to address due to the expanded complexity of jobs such as workflows. In turn, the provisioning show of all current commercial clouds assist complicates the issue: in hone, a client is charged for the number of time interims the benefit has been utilized, makes the issue more complicated. These decipher, numerically, into two critical characteristics of advanced metaheuristics: escalated and

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enhancement. While improvement ensures that the computation explores the look space in a useful manner, elevated searches for the greatest candidates or arrangements among the present best arrangements and selects the best ones. In common, most plan optimization issues in buildings are exceptionally nonlinear since they include numerous plan factors with diverse plan factors related to complex limitations. This limitation can be composed as basic bounds such as fabric properties ranges, or as nonlinear connections counting greatest push, greatest avoidance, least stack capacity, or geometrical setup. This nonlinearity is not as if it were complex in nature but is too routinely a multimodal reaction scene. Thus, local look computations like slope climbing and Nelder-Mead downhill simplex methods are illogical since global computations should be used to obtain optimal results.

2 LITERATURE SURVEY

The rapid adoption of cloud computing models by companies from virtually all industries has put resource management and optimization as one of the key concerns. Resource allocation must be as effective as possible in the realms of elasticity and virtualization, enabling the cloud's benefits such as cost reduction, scalability, and improved performance. Manvi and Shyam [1] discuss the resource management paradigm under IaaS scenarios stressing the importance of this element for operational costs, service quality, and energy consumption. The decision-making process related to cloud computing adoption for a company is complex, with the service model, workload, security, and pricing aspects. As Thomas and Oliveira [2] argue that adoptions drivers from manufacturing are different from traditional services, it is impossible to provide a straightforward model on how to decide.The importance of the problem is supported by the case study presented by Chong *et al.* [3], which investigates implemented cloud applications in the practical sphere of the built environment, and Gurkok [4] who explores cloud computing system features and critical issues. In times of workload dynamics and multi-objective requirements, the conventional method of scheduling and allocating resources in the cloud is inefficient. The LGB method developed by Navimipour and Khanli [5] is the most closely related to the current proposal in terms of the domain area, on which the authors focus; the method is based on genetic-algorithms and is applied for task scheduling on computational grids. Zhang et al [6]. Consider a multi objective nature of the cloud optimization themselves, as their work proposes optimal scheduling algorithms for cloud platforms.

Garcia and Sim [7] also address agent-based cloud environments and present a family of heuristics particularly designed for managing the 'bag-of-tasks' scheduling paradigm in cloud systems. All of these previous research works accentuate the necessity to look into more advanced, intelligent, and adaptive approaches to optimization in such complex and multi-aspect cloud environments. Nature-inspired metaheuristic algorithms have truly proven themselves as adequate tools for solving complex optimization problems. The Cuckoo Search Algorithm leverages the brood parasitism approach of certain cuckoo species [21] as a set of exploratory moves in the optimization domain as formulated by Yang and Deb [8]. These moves allow for exploring the space of possible solutions in order to find one that would meet the optimization criteria [23,24,25]. This innovative search system enables extensive search, which facilitates the discovery of possible global optima. CSA has even demonstrated adaptability to hydrology training by Santos *et al.* [9]. In a Lévy flight complement scheme, CSA found its spot, and this combination was used to optimize the parameterization of the runoff-erosion model. Research published in recent years has demonstrated the optimal candidate of CSA attracts for cloud resources optimization. Pandey *et al.* [10] was implemented a novel hybrid of CSA and Particle Swarm Optimization (PSO) and Cuckoo Search workflow scheduling in a cloud scenario, yielding outstanding results relative to employing these techniques independently .Energy consumption, SLA compliance, dependable task allotment, and cost optimization are all concerns in the cloud.

In [11] Mezmaz, Benmenar, and Mosse present a parallel bi-objective hybrid metaheuristic with a focus on scheduling for energy-aware cloud systems. Similarly, Abrishami and Naghibzadeh [12] address the problem of deadline constraint by introducing a deadline-constrained scheduling algorithm for a workflow, designed specifically for Software as a Service cloud systems. Considering the importance of dynamic and trusted scheduling for maintaining consistency in cloud applications, Wang' *et al.* [13] propose the Cloud-DLS framework, which uses trust-level scheduling.

Finally, because of the need to develop risk-averse strategies for scheduling tasks on heterogeneous infrastructures, Dogan and Ozguner [14] provide an extensive review of algorithms addressing both task matching and scheduling designed to reduce the execution time and minimize failures. Special challenges are posed by efficient cloud service scheduling and the scheduling of the underlying compute resources in the private cloud environment. The Ranking Chaos Algorithm, proposed by Laili *et al.* [15], is founded on chaos theory and provides an original way to schedule such processes. Dependencies between tasks are one of the complexities introduced to cloud applications by workflow-based applications. The suggestion made by Wu *et al.* [16] utilizes the market as a model to design a hierarchical scheduling system specifically for workflow in the cloud context. A hybrid approach was taken by Tao *et al.* [17] when they were concentrating on conserving energy in cloud service scheduling. The authors fused Pareto-solution-based search capabilities of genetic algorithms to achieve a better energy-efficiency and balance when making scheduling arrangements.

3 PROPOSED METHODOLOGY

3.1 *Proposed system*

The framework proposed a modern developmental calculation which is named multi objective cuckoo look calculation to plan the assignments in Cloud computing. A Multi Objective Cuckoo Look (MOCS) strategy has been defined to bargain with multi-criteria optimization issues. This approach employs irregular weights to combine different targets into a single objective. As the weights shift haphazardly, Pareto fronts can be found so the focuses can be dispersed differently over the fronts. Furthermore, certain species' egg-laying schedules are unexpected. Cuckoo parasites frequently select a nest site where a bird has placed its own eggs. Cuckoo eggs typically hatch a little bit sooner than their own eggs. Upon hatching, the first instinctual behaviour of a cuckoo chick is to "roll them out of the nest," or remove its own eggs. As a result, the cuckoo chick receives a larger portion of its own bird's food. A few trials are mentioned to show that a cuckoo chick would even cry to acquire extra time for feeding. The commit brood parasitic behaviour of certain cuckoo species, which is impacted by the Lévy flying behaviour unique to some avian and fruit flies, provides the basis for calculating the CSA. Let's take a quick look at some crazy cuckoo species.

3.2 *Algorithm used*

The Cuckoo Search Algorithm domain inspired by the brood parasitism nature of some cuckoo species offers a strong foundation for resolving the many optimization challenges typical of cloud resource allocation [21,22]. The animal signifies the idea behind the algorithm through this egg-laying behavior. It decides the designers' solutions for a nest in the formula, the chosen program of their beliefs, and the replacement preference process [23,24,25]. These Lévy flights allow the algorithm to move evenly across the solution space searching for potential optimal solutions without becoming trapped in a suboptimal solution. The effectiveness of the CSA in the cloud resource allocation problem greatly depends on how effectively the problem is modelled. In other words, what is important is the "problem-oriented" search method. Specifically, CSA starts with the solution representation: the search space should be represented as "nests", where every nest is a solution of the assignment of VMs to PMs. After that, an objective function should be created in such a way that CSA can evaluate the performance of some solution by the given set of VMs, PMs, and activity. Finally, the CSA's parameters – such as the population size; Lévy flight parameters, and the "rate at which worse solutions are dumped" must be adjusted to ensure the optimal outcome from the CSA's utilization for the specific problem of resource allocation [8,26,27]. There are several main advantages to CSA for cloud resource allocation. First of all, it's "ability for global exploration facilitated with Lévy flights is particularly useful for complex optimization problems when traditional optimization techniques may fail" [8]. Furthermore, it is rather simple to implement contrasting to other metaheuristic methods [26,27]. Moreover, it should be stressed that the flexibility of the objective function and parameters customization enables CSA to cover a large array of cloud optimization objectives. Nevertheless, considering the need for parameters tuning for the best performance of CSA, some learning curve is to be expected, which can be solved through experiments [8]. At the same time, the possible scalability of CSA should also be investigated to be more confident about solving very large-scale cloud resource allocation tasks. In summary, the CSA presents a viable method inspired by nature to address the issue of allocating cloud resources. Its efficacy, flexibility, and simplicity make it a strong candidate as a new approach for addressing the challenges of efficient cloud resource management [8,26,27]. With continued research and exploration, especially in the areas of hybrid approaches and large-scale deployments, the CSA is poised to play an even more significant role in the future of cloud optimization. System Architecture is shown in Figure 1.

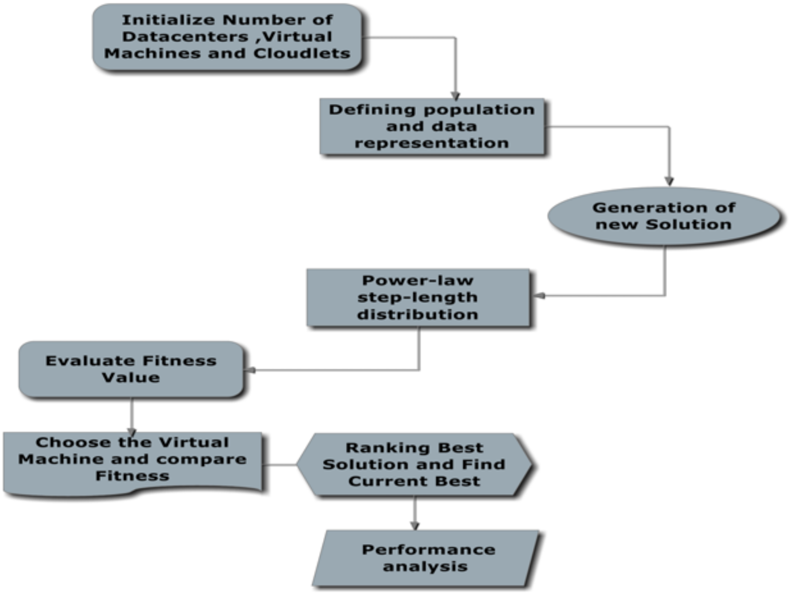
Initialize Number of Datacenters ,Virtual Machines and Cloudlets
Defining population and data representation
Generation of new Solution
Power-law step-length distribution
Evaluate Fitness Value
Choose the Virtual Machine and compare Fitness
Ranking Best Solution and Find Current Best
Performance analysis

Figure 1. System architecture.

4 EXPERIMENTAL RESULTS

The study demonstrates the significant potential of the Cuckoo Search Algorithm (CSA) in optimizing cloud resource allocation. Through a rigorous experimental methodology and have established its efficacy in dynamically managing resources to address fluctuating workload patterns in cloud environments. The results indicate notable improvements across various key metrics like Resource Utilization, Response Time and Cost Effectiveness. Optimization of Allocation of VM's as shown in Figure 2.

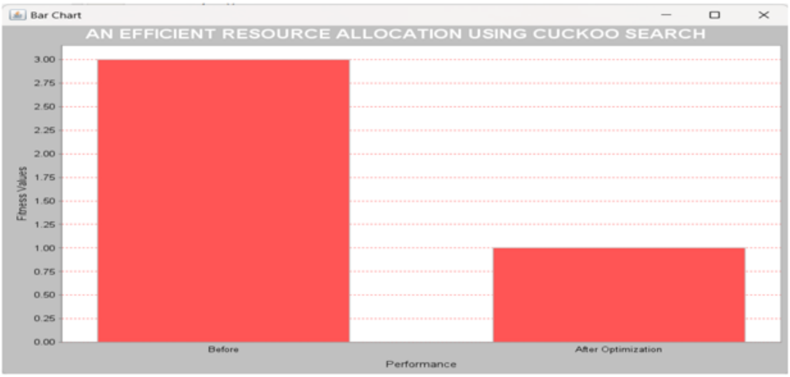

Figure 2. Optimization of allocation of VM's.

5 CONCLUSION

Cloud computing is an innovative computing technique that utilises the internet and centralised remote servers to store and manage data and applications. Cloud computing is a contemporary model of computing that is distributed. It encompasses IaaS, PaaS, and SaaS are conveyed as subscriptions services. Cloud services are provided to consumers on a pay-as-you-go model. With cloud computing, user applications can dynamically provision an arbitrary number of computing resources wherever and whenever required. Scheduling of tasks in cloud computing is highly sophisticated. Algorithms and policy for scheduling in application is to schedule applications cost efficiently and effectively on cloud computing and data centres' environment and additional resources one possible approach to scheduling is to use an objective function, such as minimising the total execution time. Minimize total cost to execute, balance the load of resource used and also ensure that the application meets its deadline constraint and so on. Hence, the cuckoo search algorithm is a better and easy way of finding the optimal solution in scheduling. The cuckoo algorithm Framework I am going to use in scheduling however demonstrated that the scheduling of resources is a better solution compared to cuckoo search whereas it better in the framework that is in visual studio.

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An imitation of humanoid robot: A qualitative analysis

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ABSTRACT: Robots that resemble humans are becoming more and more integrated into society, which has raised important questions about whether or not these machines can imitate and duplicate human behavior. The relationship between imitation and humanoid robotics is explored in this work, which also looks at the challenges, advancements, and outcomes associated with building robots that can mimic human behavior. Clarifying the value of imitation for humanoid robots, the study's first portion emphasizes how imitation fosters social integration, adaptability, and human-robot interaction. A thorough examination of the research shows how far imitation skills have come in terms of things like motions, expressions on the face, and even feelings. The study also explores various techniques for humanoid robots to imitate human actions, ranging from traditional rule-based programming to the rapidly advancing fields of artificial intelligence (AI) and machine learning. Researchers are extensively investigating the potential of robots to learn, understand, and replicate human-like behaviour. Deep learning algorithms, neural networks, and cognitive models offer promising avenues in this endeavour. As these robots become more proficient at mimicking human behaviour, regulations and ethical principles are increasingly important factors to consider.

Keywords: Artificial intelligence, deep learning, cognitive models, imitation, human-robot interaction, interpersonal relationships, technological evolution

1 INTRODUCTION

The development of humanoid robots has marked a turning point in technological integration and sparked serious questions about the robots' capacity to mimic and duplicate human behaviour. Imitation plays an increasingly significant role in the growth of these robots as they proliferate throughout various spheres of society. Imitation is a basic human link, and it has the potential to transform humanoid robot capabilities. These robots aim to beyond mere functionality and attain a degree of integration that amplifies flexibility and social interactions by imitating human movements, attitudes, and feelings. Impersonation and humanoid robotics can work together to enhance human-robot communication and promote social norm integration. We present our findings from a multimodal analysis as we explore the challenging field of imitation in humanoid robotics. We are conducting further research to understand the humanoid robot imitation process. The debate revolves around the transition from traditional law to the dynamic field of artificial intelligence (AI) and machine learning. With support, robots can learn, adapt and change their behavior in

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response to human input. Deep learning algorithms, neural networks and artificial intelligence can be easily implemented. This research will provide guidance in discussing non-destructive technologies needed for future technological developments. High-performance humanoid robots can perform multiple tasks simultaneously. On the other hand, discuss the ethical issues arising from the creation of high-performance robots. Consent, privacy and social impact are just some of the issues that need to be carefully considered. As these robots begin to become more human-like and transcend their primary role as machines, the need for legal and ethical standards remains. This research explores the complexity of technology that could be used to create humanoid robots in the future. It is easy to operate and adapt to many situations. Through our understanding and use of humanoid robots, we are creating technologies that have the potential to improve the human experience while carefully debating the ethical implications of this shift.

2 LITERATURE REVIEW

The application of mimicry in humanoid robotics has become a fascinating area of research demonstrating communication between humans and robots. Important role of behavior in humanoid robots: Researchers have long discussed the importance of behavior in humanoid robots in terms of its importance in human interactions .It is believed that humanoid robots can solve social problems and bring comfort and confidence to people in business life (Breazeal 2003; Billard et al. 2006).

2.1 *Basic steps of humanoid robot simulation*

The development of basic concepts for teaching humanoid robot simulation is a recurring topic in the literature. Despite the importance of law, it has been replaced by methods based on artificial intelligence and machine learning (Nehaniv and Dautenhahn 2007). Deep learning algorithms, neural networks, and artificial intelligence are increasingly used to help robots learn and adapt to human behavior (Gupta et al. 2019; Kuniyoshi et al. 2018).

2.2 *Ethical issues*

As humanoid robots get better and better, ethical issues become more evident. Information on this subjects. To ensure justice in the creation and use of intelligent robots, researchers recommend the development of justice and law (Sharkey and Sharkey 2010; Winfield et al. 2014).

2.3 *Integration of humanoid robots*

Scientists have examined the relationship between integration and behavior and have shown that the performance is very good, allowing humanoid robots to adapt to many situations (Fong *et al.* 2003; Kanda. *et al.* 2004). This combination can be used for medical, educational and other purposes as needed.).

3 PROPOSED METHODOLOGY

This study examines skills, content knowledge, and ethics in robotics assessment.

3.1 *Setting up the experiment*

3.1.1 *Choose a humanoid robot platform*

Make sure the platform has advanced actuators, sensors, and simulation capabilities.

3.1.2 *Create repetitive tasks*

Explain a variety of activities involving many aspects of human behavior, including gestures, faces, and speech. Happy answer. Calibrate the robot's actuators and sensors to ensure accurate replication of human activities.

3.2 *Tasks*

3.2.1 *Policy-based*

Create an application for comparison using policy-based methods.

3.3 *Knowledge development*

3.3.1 *Kinematic analysis*

Analyze robot movements and compare with iso-kinematics to measure the accuracy of human behavior.

3.3.2 *Skills*

Your employees Smart metal follows people's usage ideas and instructions In teaching methods and the use of mental methods in its use.

3.3 *Ethical considerations*

- Evaluating the privacy impact of robots is important to determine how the user's privacy will be affected. Level of understanding.

3.4 *The technique of quantitative analysis*

3.4.1 *Performance requirements*

To objectively assess the efficacy of various imitation models, establish quantifiable performance standards, such as imitation accuracy, response speed, and computation efficiency.

3.5 *Computer-based simulations*

3.5.1 *Simulating human-robot Interactions*

Make use of computer programs to model different human-robot interaction scenarios, taking into consideration contextual.

3.6 *Integrating equations*

- Kinematic equations are a useful tool for characterizing the motion of robot joints in imitation tasks, as they allow for a quantitative comparison with human movements.

3.7 *Frequent fine tuning*

- Iteratively improve the imitation models by making inferences based on test results and user comments. Data of Humanoid Robot is shown in Table 1.

Table 1. Data of humanoid robot.

ROBO	YEAR	MANUF.	h (cm)	W (kg)	Limitation capabilities	AI Integ.	Noble Features
ASIM	2000	Honda	130	54	Basic gestures, walking	No	Advanced mobility, human like movements
Atlas	2013	Boston Dynamics	150	80	Dynamic Movements	Yes	Agility, mobility, dynamic
Sophia	2016	Hanson Robotics	–	–	Facial Expression	Yes	Human-like facial features, conversation capabilities
Pepper	2014	SoftBank Robotics	120	28	Basic Intractions	Yes	Emotional recoginition, social interactions
Spot	2020	Boston Dynamics	84	30	Quadrupedal	Yes	Robust mobility, versatile applications
icub	2004	RobotCub consortium	104	22	Advanced gestures	Yes	Cognitive development, research in human cognition
Nao	2006	SoftBank Robotics	58	4.3	Basic gestures, walking	No	Educational and research applications, programmable

3.7.1 *Algorithm*

Step 1: Initialization:
Configure Sensors and Actuators:

- Modify the sensors (such as accelerometers, cameras, and gyroscopes).
- Assign configurations to actuators, like joint-controlling motors.

Configuring the System:

- Allow the robot's operating system to begin.

Step 2: Perception:
Acquisition of Sensor Data:

- Constantly read data from sensors.

Identifying Objects:

- Identify and classify objects around you by using computer vision algorithms.

Mapping the Environment:

- Utilizing sensor data, create a map of the robot's surroundings.

Step 3: Task Planning:
Making Decisions:

- Formulate a strategy or sequence of steps in response to user instructions and the observed surroundings.

Step 4: Execution of Action: Movement Management:

- To perform predetermined actions, turn on motors, and control joint motions.

Capturing and Performing Motions:

- When emulating human conduct, use motions that bear resemblance to discernible actions or gestures.

Step 5: Relationship:
Human-Mechanized Communication:

- Interpret nonverbal cues, such as gestures and facial expressions, and react accordingly.

Identification and Emotional Reaction:

- Read people's facial expressions if you can, and respond appropriately.

Step 6: Learning and Adaptation:

- Apply machine learning techniques to continuously learn and adjust to various environments and jobs.

Step 7: Safety and Mistake Management:

Avoiding Collisions:

- Implement algorithms designed to identify obstacles and avert collisions.

Error Resolution:

- Offer mechanisms to identify and rectify errors in sensor data or operation.

Step 8: Shutdown:

Graceful Shutdown:

- Safely turn off the robot's systems after the task is completed or if you receive a shutdown instruction.

3.7.2 *Algorithm flowchart of normal working of humanoid robot*

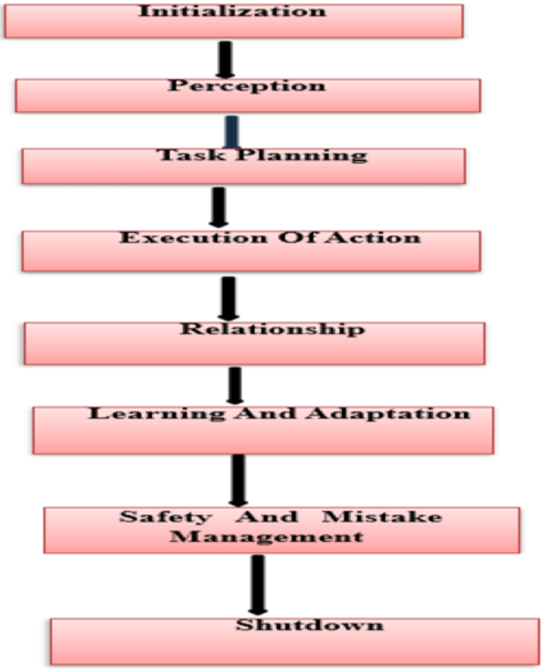

Figure 1. Flowchart.

Figure 1 shows the flow chart of working of humanoid robot.

4 CONCLUSION

The dynamic environment at the intersection of robotics, artificial intelligence, and human interaction has been made clear by research on humanoid robot mimicry. By thoroughly examining the technical, cognitive, and ethical elements, this work clarifies the advancements made in the ability of humanoid robots to imitate and replicate human behavior. Regulatory frameworks and ethical standards, however, are essential to direct the proper development and use of new technologies, considering the ethical problems around permission, privacy, and potential impact on interpersonal interactions. This study emphasizes the importance of striking a balance between innovation and morality to ensure the seamless integration of humanoid robots into the fabric of human existence, with an eye toward a future in which robots that can mimic humans and live in a variety of social contexts. While simultaneously clearing the way for creative uses that enhance human experience at the forefront of technical innovation, the study emphasizes the moral issues that ought to motivate the ground-breaking integration of humanoid robots into our daily lives.

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An Insight into the world of Virtual Reality (VR)

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ABSTRACT: To get a real-time experience of what we have read in novels like Marvel, Harry Potter is now in existence. As the technology is now at its full par, the evolution of cinematography from theatres to VR has taken place. Some VR products are starting to emerge due to the rapid advancements in optical elements, display technologies, and digital processing. VR is virtual reality, where the computer provides the user with a real space environment to interact with it with every experience. By playing it safe and approaching it from a learning standpoint, we can experience the most terrifying and taxing situations through virtual reality. People can connect with computers in a natural, easy, and efficient way thanks to it. Users can simulate the environment just as we would in the real world, without having to learn how to use the intricate (and often awkward) user interface.

Keywords: Virtual Reality (VR), Cinematography Evolution, Immersive Experience & Optical and Display Technologies

1 INTRODUCTION

With emerging technology, our world would look more like a computer system in which tech is our CPU and we humans are its software. To name such technology, one is Virtual Reality (VR). That being said there is no accepted definition of virtual reality, doing so can be challenging. It is claimed to be an oxymoron since one school of thinking refers to it as a "reality that does not exist." VR is not new to existence as it is a modified version of what we call theatre. In the 1960s, Morton developed the Tele Sphere Mask and Sensorama, which served as the first VR-related invention [1]. The initial technologies were created to immerse the user in the video display all around them and give them the impression that they are a part of the video. Ivan Sutherland came up with the idea for The Ultimate Display, which is based on a similar idea of using a variety of input and output devices to let the user feel fully immersed in a computer-generated environment [2]. Virtual Reality is also known as Virtual Environment. VR is the 3-dimensional real-time illusion of a graphically designed environment with features like display technology, stereoscopic head tracker displays, binaural sound, computer graphics, image processing, pattern recognition, artificial intelligence, networking, sound systems, and others to produce computer simulation and interaction which gives the experience of physical reality.

Based on the eye-to-brain imaging process, virtual reality (VR) seeks to provide crisp images that can replicate, blend into, and rebuild the surrounding environment without causing wearer discomfort. If visual comfort fails to meet these requirements, the viewer may experience unreality, confusion, or even vertigo and nausea. This field involves various disciplines of technology like human anatomy, human engineering, electronic and mechanical, cybernetics, database design, etc. which is being used to solve problems related to hardware, software, human factors, and VR over high-speed networks. The best thing about virtual reality (VR) is that it allows users to practice these tasks in a safe environment and become sufficiently immersed to feel realistic, transferable to the real world, and accurately depict nearly any

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scenario. Soon, VR developers will expand this sensory hijacking to include our other senses, such as touch and scent, to heighten the impression of immersion. The extended reality (XR) – a term that covers virtual reality (VR), augmented reality (AR), and mixed reality (MR) – will be one of the human consumption trends for the next five years, enabling super-fast networking, which will let us implement VR as a cloud service fair like we presently grasp music and movies.

2 HUMAN-VIRTUAL WORLD INTERACTION

Human senses are employed by technology to sense virtual things. They are mentioned in the motion platform, FOV, eye box, angular resolution, dynamic range sound feedback, tactile and force feedback accurate depth cue as well as visualization devices. [3] Thus the relationship allows the representation to interact with in virtual environment. The quality of any VR system will be determined by the feature set it offers. Triage means three 'I's mutually known as threeImmersion means focusing solely on the work the user is working on without getting distracted by any means. [4]

- Interaction is a form of communication with the system in a virtual world where the use of 3-D means like space balls and head-mounted devices (HMD) are featured unlike the traditional use of 1–2 dimensional (1D, 2D) devices, such as a mouse, keyboard, or keypad, is known as human-computer interaction. Real-time response, efficacy, and human participation are a few aspects of VR system interaction.
- Imagination can be viewed as the organization designer's concept to accomplish a particular objective, due to the components of the VR system's utility for complicated problem-solving in a variety of sectors, as well as its use as a more clever and efficient way to advise ideas than aged 2D draft or text. To altogether immerse the user in a virtual environment, virtual reality requires both software and hardware technologies. HCI, also called human-machine interplay (HMI) refers to the interfaces between computer engineering and people as users.

The entire VR system relies solely on the computer's algorithm to recognize human behavior. How virtual universe works? First of all we have to look at how the human vision and visual technology system brings us all the way into existence both the visual display. With regards to the VR display, we have tried to look at the following human vision constraints like FoV, eye box, angular resolution, dynamic range, correct depth cue etc. So now we know these terms first let me you understand,Then we will relate these with the working of a VR Headset. The human vision has a maximal horizontal field of view (FoV) of 120° for overlapped binocular vision and 160° in monocular. When all the lines of light converge the exit pupil or eye box! Eye Box: The distance (up, down, left and right) the eye can move off of a perfect position and still perceive an image with no degradation. The larger the tolerances of an eye box, the better it can adapt to a user's changing interpupillary distance (IPD) and wiggling headset while in use. Angular resolution is the aggregate of sharpness in the publicize panel by FoV, which defines the clarity that is there for a perceived image. After some thought, a person with 20/20 vision is equivalent to 1 arcmin resolution or, essentially, 60 pixels per degree (PPD); this is considered the common target for AR and VR displays.

3 COMPONENTS OF VIRTUAL REALITY

3.1 *Input devices*

They are hired to interact with virtual environment objects and the virtual environment itself. Keyboards, instrumented gloves, joysticks (wands), voice recognition, etc. are a few examples.

3.2 *Process acceleration card*

These cards assist in adding fresh sensory data to the display. Three-dimensional graphics and sound cards are two examples.

3.3 *Computer workstation*

A high-end microcomputer designed for use in a scientific or technical field is called a computer workstation. Workstations, which are usually designed for one person to use at a time, are operating systems that support multiple users and are linked to a local area network. The mainframe computer terminal is also referred to by the term "workstation." or an individual PC linked to a network. Workstations provided greater speed than personal computers, particularly in terms of CPU capacity as well as graphics, memory size, and multitasking ability. They are geared toward the manipulation and display of various complicated information like animation from an engineering simulation, 3D mechanical design, and rendering of graphs in mathematics and images. The first are workstations. The computer market offers cutting-edge accessories and working together.

3.4 *Tracking system*

This system monitors a user's orientation and position within the virtual environment. There are four categories for this system: infrared, ultrasonic, electromagnetic, and mechanical trackers. For many years, the working principle of VR systems has been electromagnetic. Generally, electromagnetic signals emitted by a stationary transmitter are intercepted through a moveable detector worn on the user's head. After the detector picks up these signals, decodes them to show the relative orientation and location of the receiver concerning the conveyor. After that, these signals are transmitted to the run-time system for sending data to a 3D visual environment. [5] The 3D mouse is tracked using the same principle, the user's field of view can be controlled through signals.

3.5 *Sensory display*

The simulated virtual worlds are proven to the consumer through sensory presentations. Head-mounted displays (HMDs) for 3-D visuals, laptop visual shows, and headphones are the most popular forms of sensory displays for 3D audio.

- Head Mounted Display: The display devices, also known as head-mounted tablets, are set precisely in front of the wearer's eyes via a head mount. Digital content is thus projected on his field of vision. Usually, a camera has been embedded so that the user may capture what's going on in his field of vision and share it online. Head-up display glasses and display glasses alone are terms that are occasionally used. Two types of head-mounted displays are distinguished: monocular and binocular.
- Monocular head-mounted: In industry, displays are often used. A headframe or helmet is used to position the display in front of the left or right eye, allowing the other eye to resume seeing the environment precisely.
- Binocular Head Mounted: Presents the position to both eyes. Here, a distinction between VR and AR glasses is made. The individual possessing virtual reality goggles wears a head display that isolates them from their surroundings. He to see what has been only allowed to be displayed to him on the glasses' displays. These glasses are common in simulation training or the gaming scene. Smart glasses and mixed reality glasses, which project digital content into the real world, are more suitable examples of binocular head-mounted displays for work environments. Initially, the glasses' lenses are transparent, permitting the wearer to see the world around them normally. Digital data is only implemented when necessary. All glasses with a display, whether they be virtual reality or augmented reality, are frequently referred to as data glasses or smart glasses in colloquial speech.

4 VIRTUAL REALITY SYSTEM CLASSIFICATION

There are several technologies used to make virtual reality possible. VR technology can be classified into three basic types based on their immersion levels: non-immersive, semi-immersive, and fully immersive. Each type differs in its use cases and applications. We have simulation-based systems in this class. Systems based on projectors, avatar images, and desktop systems.

4.1 *Non-immersive vr system*

As the name implies, these VR techniques are the least used. It entails setting up virtual reality on a desktop PC. Another name for this course is Window on the World (WoW) (Oneself, 2006). When utilizing the desktop computer, the virtual world is displayed using a standard high resolution through a window or portal observation. Conventional methods are one way to interact with the virtual environment.

4.2 *Semi immersive VR system*

A semi-immersive virtual reality system consists of a relatively high-performance graphics computer system that can be connected to multiple television projection systems, a large screen monitor, or a large screen projection system. Using a broad perspective, these systems heighten the sense of presence or immersion encountered by the user, and stereographic imaging is possible with the use of some kind of glass shutter.

4.3 *Immersive vr system*

Here, the user can see the virtual environment via a head-mounted display (HMD) which includes a Binocular Omni-Orientation Monitor (BOOM), together with several haptic and tracking device gadgets. Small monitors are positioned in front of each eye by an HMD or BOOM, which deliver monocular, bi-ocular, or stereo images.

5 THE WORKING OF VIRTUAL REALITY

Virtual reality (VR) aims to create the sensation of being there,more important is the ability for the image to instantly alter as the point of view does (Smith & Lee, 2004. Among the strongest is perspective, which is especially potent when seen in two dimensions because the correct and left eyes perceive distinct visuals. Combining these photos into a single 3D impression is the foundation of stereography. Eye parallax, the illusion of depth created by each eye seeing a marginally different image, is most useful for items that are close to you. Things further away practically projected the same picture in every eye. Wearing a helmet with goggle-like displaysone for each eyeis the standard VR dress code. Every display presents an ever-so-slightly-different perspective image of what would be present. The image updates quickly as you move your head, giving you the impression that you are making these adjustments with your head movements rather than the computer genuinely tracking your motion, which is the case.

5.1 *The POV regarding the new evolution of technology (VR)*

Virtual reality is a nascent technology, so it should come as no surprise that its future is terribly exciting. The expectations of people with regard to it is actually far more than what technology can do at the moment. However, with every new discovery comes a flip-side of “darkness” – that comes in the form of doubt and mistrust (think nuclear energy) It is beneficial against the factual aims, but also can be misused. The level of anguish escalates depending to its intensity. With our increased interest in the potential of virtual reality (VR) to shape society, this may end up having an unprecedented ripple effect on human evolution. The way in which people live and behave will change fundamentally through virtual reality.

As we show up more and more in virtual space, the “migration of our time” will result in major cultural, economic and worldview shifts. We will likely take the ideals behind basic human liberties into virtual space in much the same way that the design of virtual environments (e.g., social spaces, objects, and interaction regimes) or techniques (such as “virtual genetics”) that impact human behavior are dropped in there; these new instruments for governing how we relate to one another, if not for ruling one another from here on out, serve some function of maintaining social stability as we transition from an old regime of socio-political development to a new one which sustains our freedoms and well-being. Virtual Reality (VR) has quickly carved out a home in the following areas of marketing, healthcare, real estate, gaming, mass media, fiction writing as a form of storytelling (along with television and film), music videos, heritage research and the fine arts. But an intense focus by the media at the beginning of this decade launched it into some very significant consciousness. Finally, economic and high-performance hardware enabled the deployment of many public instances. The arcades were the first, action games for computers had an element of immersion through HMD and monitoring program. Their huge success, similarly prompted others to follow them with their own entertainment systems; flight simulators, dungeon games, multi-user racing cars and other people. In the treatment of phobias and mental disorders, patients with disabilitieseducation, etc., there have already been attempts to use VR systems.

6 APPLICATIONS OF VR

6.1 *Medicines*

Virtual reality rehabilitation for an array of anxiety and psychological disorders has become the subject of numerous clinical psychology studies, among which explore the technology’s potential use as a phobia exposure tool. Several significant studies have demonstrated how well virtual reality works to treat acrophobia.For health care providers, whether they are junior physicians explaining diagnoses and treatment plans or orthopedic surgeons performing surgery, virtual reality (VR) is a useful instrument to better prepare for operating room experiences. Thanks to entrepreneurs like Osso VR, surgeons can practice on virtual patients and participate with surgical instruments in virtual reality (VR), which helps them become more at ease with and proficient in implanting new devices. VR is frequently applied in the healthcare sector to demonstrate the anatomy of a live body rather than a mere virtual corpse.

6.2 *Tourism*

A significant development in virtual travel has tended to result from the worldwide pandemic and lockdowns, but plenty of individuals continue to lack the opportunity to travel to other nations, view renowned attractions, and soak up local culture. With VR, this can be possible. Even better, you can travel from every corner of the world. Owing to breakthroughs in virtual reality tourism, you may organize your vacation ahead of time in the post-COVID era. Incoming travelers could visit stores in multiple countries to experience their vacation [6].

6.3 *Education*

Virtual reality (VR) creates a chance to completely transform educational institutions by allowing students to acquire knowledge in an immersive, hands-on way wherever they are in the world. Virtual reality (VR) offers an opportunity to democratize education by providing pupils from all backgrounds advantages they simply might not have had beforehand. As an illustration, Victory XR and Engage collaborated to deliver virtual twin campuses in which students may participate in live, interactive lectures from elite academics. A range of training programs (such as driving instruction, sport coaching, flight simulation, military or astronaut training, etc.), and applications that explain natural laws for example, putting the user in between molecules or inside of a hurricane or allowing them to travel the galaxy), and even online learning environments. Soon, lecture halls will become commonplace.

6.4 *Job interviews*

In most businesses, the belief is that face-to-face interviews result in a better recruitment solution; business and candidates must adjust to this new way of living made possible through virtual interviews. If we can do work virtually, why not hire virtually too? It boils down to trust, and trust is a seed that needs to be sown before the flower can blossom.

6.5 *Military and air force training*

Virtual reality has been utilized to show military personnel, mariners, airmen, and marines how to care for and fix ships, aircraft, and numerous other equipment throughout the beginning of the innovation. As an example, Avatar Partners supplies applications and development support for the US Army, Navy, Air Force, and more to prepare soldiers for deployment. The platforms that are offered by Avatar Partners may benefit flight crews and maintenance employees by providing mission planning instruction and rehearsal space to boost both efficiency and security. Applications for the company minimize waste, resource shortages, and decision cycle times by boosting logistics, energy efficiency, and information value [8].

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Artificial intelligence for HR 4.0: A conceptual framework

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ABSTRACT: Human Resource 4.0 (HR 4.0) with the integration of Industry 4.0 and artificial intelligence (AI) in existing HRM settings, is projected to significantly affect the human resource domain. This paper attempts to explore numerous aspects of such AI integration with HR processes and practices that lead to transformative HR outcomes, steering the path forward toward paradigm shifts in recruitment, training and talent development, employee engagement, retention, and holistic decision-making processes. The prowess of AI can be leveraged by HR4.0 to analyze big data to synthesize deep learnings on employee preferences, performance, and organizational dynamics. HR4.0 would empower managers to make informed decisions, identify trends, and implement reforms desired to enhance employees' productivity and workplace experiences. While AI-enabled support focuses on mundane administrative tasks, HR teams can divert their focus to other strategic HR functions. AI-driven platforms could support the customization of learning and development interventions, ensuring that people skills remain relevant in the current work ecosystems. AI in HR 4.0 also poses several ethical challenges, such as data security, privacy, and bias concerns. Organizations therefore need to promptly address these challenges and prioritize responsible AI applications to deliver fair, transparent, and accountable decisions. This prospect paints a transformative landscape, smoothening HR processes, enriching employee experiences, and nurturing strategic associations between human and technological capabilities. A conceptual framework is offered after analyzing a few pertinent industry use cases offering a higher level of abstraction for HR practitioners to explore potential synergetic convergence of AI integration with HR 4.0 fundamentals.

Keywords: AI Integration in HR, Industry 4.0, Employee Engagement, Ethical AI in HR

1 INTRODUCTION

"Industry 4.0", the Fourth Industrial Revolution (*aka* 4IR) era is characterized by the amalgamation of several digital technologies (such as artificial intelligence, robotics, blockchains, internet-of-thing, augmented reality, virtual reality, mixed reality, machine learning, etc.) and robotic process automation into different industries. The Human Resources (HR) domain also witnesses dynamic transformations in its day-to-day processes and practices. Termed "HR 4.0," this development implies a paradigm shift in how HR practices are conceived, executed, and adapted to resolve the current requirements of an increasingly digital interconnected world. One of the pivotal enablers for this transformation is the rapid advancement of Artificial Intelligence (AI) technologies and its deep implications for HR strategies and functions. Evidence suggests that quick advancements in emergent technologies such as Artificial Intelligence (AI) and robotics are being included by organizations for the automation of simple, routine, and monotonous tasks. Also, complex decisions can be taken speedily and more accurately using specific predictive systems [1]. In recent times, AI

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has arisen as a disruptive force across multiple domains including the creation of intelligent agents that are capable of imitating human-like cognitive functions like communicating, learning, reasoning, and decision-making [2]. We can foresee that AI in HR 4.0 would transform all outmoded HR functions, and redefine how HR teams acquire talent, ensure better engagement of employees, achieve departmental goals, and fructify strategic outcomes. Even though organizations are struggling with the complexities of a dynamic workforce, the integration of AI into HR 4.0 processes is a key enabler that has the potential to solve existing challenges and provide novel solutions for accuracy, effectiveness, efficiency, innovation, and best organizational and operational HR performances. The potential for algorithmic bias in AI systems can delay existing disproportions in recruitment and performance evaluation. Additionally, shielding sensitive employee information and ensuring process transparency is vital to building trust while navigating the niceties of such AI integration. Consequently, the adoption of AI tools for HR 4.0 presents numerous challenges due to the complications of ensuring unbiased decision-making, managing data privacy apprehensions, and balancing automation with a human touch.

The latest trends in the adoption of AI for HR 4.0 processes and practices are continuously evolving, evident, and transforming with manifold levels of abstraction. Such adoption is proving beneficial to manage regular HR functions, namely predictive analytics for workforce planning [3]; AI-assisted recruitment [4]; heightened employee experience [5]; employee engagement and well-being [6]; learning assessments and analytics [7]; Diversity and Inclusion [8]; and much more. AI-enabled HR operations are also being explored in several other areas, such as skills gap analysis and training recommendations; continuous learning, microlearning; performance management and feedback; Robotic Process Automation (RPA); Natural Language Processing (NLP) for HR Operations; remote work management, ethical AI implementation; and a host of such objective dimensions. In this paper, along with brief discussions about recent trends in the AI adoption literature and HR 4.0 domain, a conceptual framework is proposed to abstract AI professionals and practitioners about the intricacies of AI enablement platforms. This could enable stakeholders in the domain to smoothly embrace AI, deep learning, machine learning, and related techniques in their business processes for better monitoring and improvement.

2 RELATED WORKS

2.1 *HR 4.0 frameworks*

Using a conceptual framework, Sivathanu and Pillai [9] deliberate upon the role of Smart HR 4.0 as a catalyst and disruptor of talent onboarding, development, and offboarding processes assisted by emerging technologies (for example, Internet-of-Thing (IoT), big data, AI, etc.) thus resulting in lean and efficient HR teams. Chowdhury *et al.* [10] propose an AI capability framework to unlock the prowess of AI in HR management processes and functions. It has the potential for value creation however organizations still are not able to benefit from AI adoption, even after investing a lot of resources, effort, and time. The study finds that organizations in addition to technical skills need to lay more emphasis on non-technical skills, such as human competencies, leadership, coordination, organization culture, governance strategy, and innovation mindset, to benefit from the adoption of AI.

2.2 *Digital transformation tools using artificial intelligence (AI)*

A research survey and data analysis conducted by Gaur [11] suggest that organizations need to leverage various technological tools for radical transformations in the use of people's data. Technological disruptions like Machine Learning (ML), AI, or HR analytics can help assess the efficacies of different HR functions and gain deeper insights into employees' work-life balance. Advancements in Industry 4.0 technologies have impacted significantly several business functions including HR management. Malini and Srinivas [12] in their research study observe that digital transformations are evident through the adoption of emerging technologies, such as AI-associated Machine learning (ML), Cyber-Physical Systems (CPS), the Internet of Things (IoT), 'autonomous agents and things' (Robotics), cognitive computing, cloud computing, etc. which are enabling HR functions like recruitment, onboarding, training and development, performance management, compensation, benefits, and much more in business organizations.

2.3 *Use cases: AI adoption for HR 4.0*

The following use cases are deliberated in our study to exemplify the adoption of AI in the context of HR 4.0:

Case A – Integration of AI for talent management and workforce planning: Companies use AI in their recruiting strategies or platforms to significantly enhance candidate experiences, engagement, and conversion in measurable ways. Case company employs artificial intelligence (AI) algorithms for predicting future skill requirements and detecting potential gaps among existing workforce. AI-powered chatbots enable real-time support for employees to seek answers to their HR-related queries. (for example, Robert Neuhauser (2021, June) [13] from Siemens Global Head of Talent and Leadership, highlights technological progress in speech recognition systems, text creation systems, and translation services as enablers of artificial intelligence in HR innovations. Several advances in individualization/personalization technologies especially in social media applications in the HR realm can be incorporated for the identification and ranking of talents, improvements in employee health, and predicting salaries. Implementation of AI and machine learning in HR practices could help not only in automation but also enhance personalizations within talent acquisition requirements.

Case B – AI-powered talent marketplace. The case company launched a novel internal online talent marketplace that helps employees extend their career boundaries using an AI-powered talent platform such as 'FLEX experiences' that assists in identifying personalized open opportunities in a real-time environment. It encourages teams to create a capability from lifelong learning by accessing the platform where employees can choose small or large projects to work on, increase the depth of their expertise, or build new experiences and skills. AI supports this by providing suggestions that match the profiles and aspirations of people. [14].

Case C – How AI is changing work? A new study from IBM reveals that AI is changing the way work is done and raises serious concerns for HR leaders as to what they need to do. Jill Goldstein (2023, August), Managing Partner from the Talent Transformation and Consulting department discussed the rise of generative AI and its impact on the workforce. Several talent-related challenges arise with the integration of AI leading to the skills gap, shifting employee expectations, impact across various employee groups, and augmented capabilities, thus impacting several other HR processes [15].

3 CONCEPTUAL FRAMEWORK

The AI technology and paradigm seem to assure greater opportunities thus revolutionizing both for humans and Industry 4.0 necessities. The discussed use cases exhibit several advances in the HR 4.0 domain and offer high potential in harnessing AI-integrated products and services for all relevant stakeholders, continuously evolving in their prowess, and HR outcomes, including automated and optimized transactions for its users. Embracing AI into HR 4.0 can enhance the effectiveness and efficiency of HR management and functions in myriad ways. Some benefits that can be derived include automation of processes, data-driven insights for enhanced decision-making, unbiased selections, improved acquisition/sourcing of talent, tailored learning for personalized employee experiences, predictive analytics, employee engagement, cost savings, scalability, compliance, accuracy, and several other HR related analytics.

However, it also poses a fair share of its challenges which also need much equal attention. These include the quality of data, privacy concerns, ethical concerns, lack of human interactions, need for reducing biases, ensuring fairness, legal/regulatory challenges, customization, adaptability, trust factors, right AI vendor selection, upskilling, change management, and much more. It also necessitates strong collaboration between HR, legal, IT, and other relevant departments for a holistic approach and effectiveness in such AI implementation for HR 4.0. A framework that can address these preliminary concerns is therefore necessary.

It is foreseen that the adoption of AI in HR 4.0 offers the potential to drive innovation, enhance employee experiences, and contribute to organizational success. In this section, we propose such a conceptual framework based on our learnings from the above-discussed literature and use case scenarios (refer to Figure 1) to address the AI adoption for HR 4.0 requirements.

The framework needs to be further tested in various industry domains to understand and evaluate the impact of AI adoption in the HR 4.0 context as shown in Figure 1.

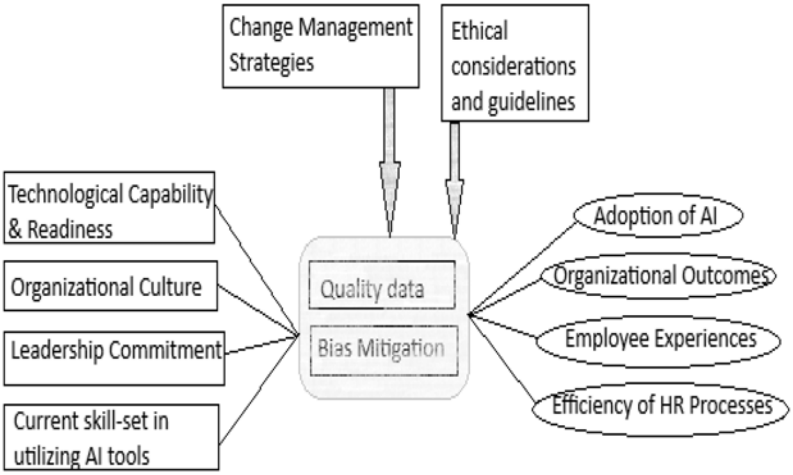
Change Management Strategies
Ethical considerations and guidelines
Technological Capability & Readiness
Organizational Culture
Leadership Commitment
Current skill-set in utilizing AI tools
Quality data
Bias Mitigation
Adoption of AI
Organizational Outcomes
Employee Experiences
Efficiency of HR Processes

Figure 1. Conceptual framework on AI adoption for HR 4.0 (Source: Author(s)).

4 CONCLUSION

Artificial Intelligence is here to stay and influence our personal lives as well as business functions. The study purports to support the reasons and opportunities for businesses to adopt AI in the HR 4.0 domain driven by emerging technologies and digital transformations. AI will revolutionize several aspects of all HR functions in the context of HR 4.0 and Industry 4.0. The study reiterates that this arrangement would support HR 4.0 to optimize and benefit in its most desirable activities, such as talent acquisition, recruitment, onboarding, learning and development, performance management, employee engagement, workforce planning, automation of HR operations, bias detection, data-driven decision making, measuring success, HR impacts, and a host of other business goals. Ultimately, it will converge into a lean and agile functioning of the organization, leading to a competitive advantage in the marketplace. In line with these discussions, the conceptual framework depicts useful constructs that guide the relationship between AI integration variables to HR 4.0 outcomes, and future research directions for testing the model in various domains.

In conclusion, the adoption of AI in HR 4.0 offers great transformative potential for organizations, assists in streamlining HR processes, supports data-driven decisions, and augments employee experiences. There are diverse use cases in this regard, however, as with any technological advancement, there are bound to be several challenges that organizations must address promptly with a thoughtful and strategic approach to fully harness the benefits of AI integration in HR 4.0. Needless to say, successful AI integration in HR 4.0 hinges on ethical AI practices and should be at the forefront of AI adoption, respecting employee privacy and rights while building and maintaining trust.

By fostering a culture of continuous learning and adaptation, one can navigate any challenges and maximize the positive impact of AI on HR functions. With continuous evolutions in HR 4.0, those who embrace the real potential of AI while also addressing its challenges will certainly be in a better position to shape the future of work, drive innovation, and create a more efficient and inclusive workplace ecosystem for all.

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Artificial intelligence role in stock market: A comprehensive analysis

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ABSTRACT: It is difficult to predict stock prices in the stock market, as it is erratic. Many of the considerations above have caused researchers to develop strong and new predictive strategies. AI models have transformed stock market analysis by enabling fast and accurate decision-making and providing insights inconceivable with traditional methods. AI is very helpful to generate the comprehensive analytical report of stock market by business insider intelligence. This manuscript shows that how AI systems are revolutionizing the Fin-tech sector and capital markets — high frequency trading, hedge funds, and more. AI enables stock market easier and decision making for investors, traders and financial institutions. This manuscript expresses the swot analysis for artificial intelligence in stock market, challenges, expected applied models and applications of AI in this market. Overall, AI enables investors, traders, and financial institutions to make informed decisions, improve performance and thrive in volatile markets. Mobile applications are becoming increasingly popular both among businesses and people so that the overall use of AI technologies will only increase in the future, shaping the future of finance, and economics.

Keywords: Artificial intelligence, stock market, financial market, risk management, market efficiency

1 INTRODUCTION

AI is anticipated to cross from the back to the front office, from enhancing decision-making and effectiveness in financial markets to assisting AI-based algorithms in prudent risk management. This work franchise addressed topics connected to the applications of AI in stock markets such as data analysis, predictive analytics, algorithmic trading, and a portfolio optimizer. The main applications of AI in the stock market include the following: Predictive analytics – machine learning algorithms analyze historical stock data, including price movements, trading volumes and other market variables, identify patterns and correlations and predict future stock price movements and market trends. Sentiment analysis: NLP or artificial language processing examines news, social media posts, and other text to decipher the people's opinions and emotions. Using this information, it then predicts how news, news, and events impact the price of shares. Algorithmic trading: AI-powered trading processes grades of spearheading guidelines. Entailing they actuate buy or sell orders automatically and rapidly to trade variations. They

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additionally declivity their trade ways and strategies consistent with the trade information. Portfolio management: AI also assists in the medley of possessions, reduce and perform risk among portfolios of investment. They can periodically update the rebalance portfolios taking into account real-time data on the market and the preferences of the user. Risk management: AI-models analyze the investment risks and do their best to mitigate them. They can also detect potential threats and report them where necessary. Fraud detection – AI algorithms analyze transactions and trading activities to identify anomalies proving fraud and market manipulation in real time. High-frequency trading – AI excels in high-frequency environments where speed is crucial, leveraging algorithms to execute trades in a matter of milliseconds. Deep learning models – AI models use advanced techniques like deep neural networks to analyze complex data structures and make predictions that would be impossible otherwise [3,4].

2 LITERATURE REVIEW

2.1 *Stock market*

The stock market is the keystone of global finance, enabling a consortium of buyers and sellers to exchange shares of public companies. A living engine, it accommodates everyone from masses of individual traders to the world's largest institutional players, all of which naviage its jagged line moves in an effort to earn a return on their investment. The stock market is a hub of economic activity, innovation, and wealth, and a true reflection of the visions and expectations of it many participants [5,6].

2.2 *Financial market*

Financial Markets are a confluence of various entities that deal in money — borrowing, lending, buying, selling, and exchanging of various financial instruments. These instruments can be anything from stocks, bonds, currencies, and commodities to more complex derivatives. These markets bring together those in need of capital (the borrowers or the issuers) and those who have excess capital (the investors or lenders), directly helping to facilitate the transfer of resources and capital within the economy [7].There are several ways to classify financial markets. They can be organized around the type of instruments being traded, the geographic location, and the medium for trading such securities. Based on the type of instruments within them and the maturity of the instruments traded, they are classified into two types:

2.2.1 *Capital markets*

They deal with buying and selling of long-term financial instruments, such as stocks and bonds. The capital market can be further divided into the primary market (where a new issue is being made) and the secondary market (where existing/already issued securities are traded among investors).

2.2.2 *Money markets*

They are for short-term financial instruments that have high liquidity. These instruments usually carry little to no risk and include things like Treasury bills and commercial paper. They are crucial for facilitating short-term borrowing and lending of finance for financial institutions and corporations.

3 ARTIFICIAL INTELLIGENCE MODELS

To analyze and predict stock prices, understand stock market behavior, and manage stocks and portfolios, various models are used in stock studies and similar financial analyses. These models belong to different categories based on assumptions and methodologies. Some of the models commonly used in stock studies include as shown in Figure 1:

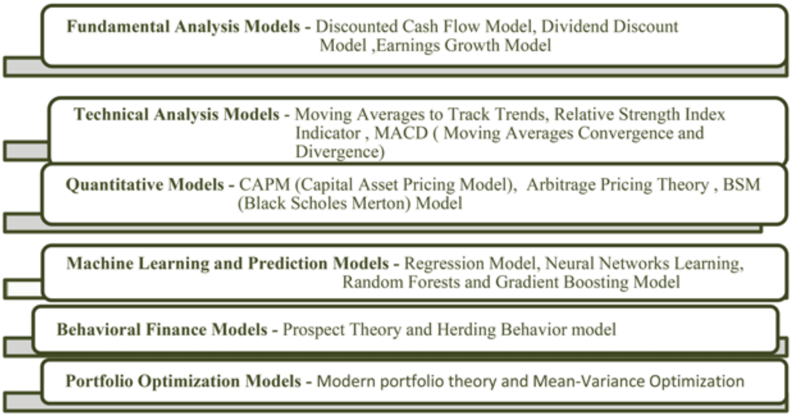
Fundamental Analysis Models - Discounted Cash Flow Model, Dividend Discount Model ,Earnings Growth Model
Technical Analysis Models - Moving Averages to Track Trends, Relative Strength Index Indicator , MACD (Moving Averages Convergence and Divergence)
Quantitative Models - CAPM (Capital Asset Pricing Model), Arbitrage Pricing Theory , BSM (Black Scholes Merton) Model
Machine Learning and Prediction Models - Regression Model, Neural Networks Learning, Random Forests and Gradient Boosting Model
Behavioral Finance Models - Prospect Theory and Herding Behavior model
Portfolio Optimization Models - Modern portfolio theory and Mean-Variance Optimization

Figure 1. Models applied in AI Stock market.

4 SWOT ANALYSIS

This analysis examines the following components:

S – Strengths – Data Analysis, Speed and Efficiency, Risk Management, 24/7 Availability, Automation.
W – Weaknesses – Over Reliance, Lack of Interpretation, Ethical and Regulatory Concerns, Complexity, Market Volatility.
O – Opportunities – Enhanced Decision Making, Innovation, Personalization, Cost Reduction, Global Market Access.
T – Threats – Cyber Security Risks, Job Displacement, Algorithmic Bias, Regulatory Scrutiny, Black Box Trading

4.1 *Strengths*

Those are the AI technology applications available in this sector. Step of matching the opportunities to the relevant strengths: One of the greatest strengths is that the artificial intelligence scope is expanding from day to day. There are many benefits of the AI in stock market sectors development. Some of them include the following:

4.1.1 *Data analysis*

AI can process a huge amount of data quickly. Therefore, it can identify patterns and correlations that human analysts might not even consider.

4.1.2 *Speed and efficiencies*

You can execute trades in milliseconds. As a result, the reaction time to the changing market is smaller with a human-trader involved.

4.1.3 *Risk management*

Assessing the potential risks and returns is quick, thanks to this AIs' ability to show them in a matter of seconds in real-time.

4.1.4 *24/7 availability*

AI moguls can work at all times. They can analyze markets in the different time zones of the globe without interruption.

4.1.5 *Automation*
Automate various tasks, not just the analysis decisions but also data collection and other routine task rates, which lowers the following operational costs and human errors.

4.2 *Weaknesses*

On the inverse, AI in stock market has a wider strength area but also a few weaknesses. These include:

4.2.1 *Over-reliance*
Heavy dependence on AI creates vulnerabilities if the underlying algorithms or data streams are broken or compromised.

4.2.2 *Lack of interpretation*
AI lacks the nuance to decipher soft factors or surprises not captured in old data series.

4.2.3 *Ethics and regulation*
The application of AI to trading can also bring up ethical questions, for example algorithmic bias or market manipulation concerns.

4.2.4 *Complexity*
AI is relatively complex cryptanalysis and oversight. High AI usage is a difficult standard for some more market members to reach.

4.2.5 *Volatile markets*
AI establishes an elevated likelihood in fair stocks loosening. The investing changes can increase volatility by reacting quickly to more sensible drawings or newspapers.

4.3 *Opportunities*

There are many opportunities of AI in stock markets. These are:

4.3.1 *Enhanced Decision Making*
AI could give investors even more profound penetrations and anticipate analytics. Subsequently, it passes cognitive tendencies that frequently impinge on designs of thought mirror as well and expound stronger assets.

4.3.2 *Innovation*
Machine learning could create more beneficial exchanges strategies and stimulate the expansion of new financial products much higher.

4.3.3 *Personalization*
AI could modify the routine, error-prone measures that could make judgments including a customized recommendation of purchase policy on an individual pedagogical assessment.

4.3.4 *Cost reduction*
AI will minimize the expense of running firm mechanisms and accumulating valuable investment to produce powerful enterprises. The most reliable payer of Big Organization helps build a valuable investment company.

4.3.5 *Global market access*
AI investing trading across thousands of international markets possible, there is no possible way to lack for diversity.

4.4 *Threats several risks are also present in the AI stock market. These include the following:*

4.4.1 *Cyber security risk*

AI systems are susceptible to cyber threats and attacks that could disrupt trading activities and compromise important data.

4.4.2 *Job loss*

Traditional trading and financial analysis jobs may be compromised as a result of increased automation through AI.

4.4.3 *Important person bias*

AI could reinforce important person biases by building on information from historical data.

4.4.4 *Regulatory risk*

Regulatory action against AI in trading to ensure fairness and transparency.

4.4.5 *Black box trading*

AI decision-making process so it cannot be easily understood and regulated possible market impact.

In other words, AI can be a powerful tool for the quick efficient decision-making process in stock markets, but it comes with level risk management, ethical constraint, and legal oversight. Integration requires a balanced approach to understand and use it exponentially.

5 CHALLENGES FACED IN AI STOCK MARKET SYSTEM

While AI also provides many opportunities in the stock market, there is a wide range of challenges that should be mentioned in the given Figure 2:

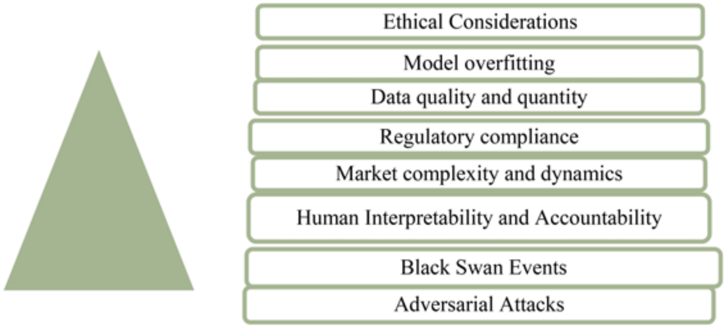
Ethical Considerations
Model overfitting
Data quality and quantity
Regulatory compliance
Market complexity and dynamics
Human Interpretability and Accountability
Black Swan Events
Adversarial Attacks

Figure 2. AI Challenges.

6 CONCLUSION

Artificial Intelligence integration has transformed many dimensions of trading and investment in the stock market. However, the sector is more dynamic and keeps developing, day by day. AI's main advantages are its ability to process large financial information packets quickly and accurately. This makes machine learning models able to analyze all historical market behavior, new-related moods, and more to try to predict the future of stock. One of the main harnesses filled with AI was people creating algorithmic trading, also known as quantitative trading. These computer algorithms are faster and more frequent than any human-trading force and often utilize patterns, somewhat inefficiencies, and arbitrage that allow making sizable profits. AI tools are also an invaluable part of figuring out what kind of risk an investment could involve, and mitigating that risk to protect one's portfolio. Some firms use AI that can consider vastly more variables than traders normally could to make a more accurate risk assessment on a trade than any human could. AI is also playing a growing role in optimizing portfolios. Systems can account for everything from current market conditions to an investor's finances and risk tolerance to recommend the portfolio composition that stands the greatest chance of offering the best overall performance. The portfolios are, in many cases, automatically adjusted. It's used as part of monitoring and surveillance systems, too. You can catch market manipulation, fraudulent activities and trades that are wildly unlikely given known data. This prevents regulatory violators, protects investors and maintains market integrity. As AI plays a larger role in stock trading, however, there are questions about transparency, accountability and fairness that are largely unaddressed. Making sure that AI-driven systems for trading, risk or surveillance are used wisely is becoming crucial for maintaining trust in the financial markets.

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Artificial intelligence – the future of education: A review

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ABSTRACT: Artificial Intelligence has been developed so much that it has influenced every sector. Education is among one of those sectors. Education incorporates a vast sphere that ranges from early childhood learning to higher education and beyond. Education has no end but it is always misunderstood that education is just based on schooling, but it is much more than that, learning a new skill, learning about new technologies, learning new languages and so much more comes under education and Artificial intelligence has simplified this complex task of learning. We can't summarize the vast notion of education by just merely equating it with conventional learning based on the school. These different forms of education have different requirements so just depending on traditional learning is a monotonous and tedious process that is not practical as learning requires implementations, requires simulations, personalized or tailored learning or sometimes need interactive sessions specifically while learning a new language. and AI can fulfill each of the mentioned requirements. It has been observed that AI has positively affected education. Some examples are intelligent training systems, practical and efficient learning programs, chatbots etc. which indicate advancements in the education sector. This paper includes a brief review, how it is contributing to the field of education, what are the new technologies that have been integrated and the enhancements in the field that have been made so far.

Keywords: AI, Future of education-learning, E-learning, Education

1 INTRODUCTION

"Artificial Intelligence" is capability to control machine to do any work or task that would have required a human mind. For example, autopilot modes present in aircraft are an example of AI. AI is an expansive domain that includes all the historical advancements. Recently, there has been marked a slight boost in the number of usance where "artificial intelligence" is being utilized and tends to be more efficient. It has become so common that if its capabilities get well known, it is commonly referred to as "software" [1]. For the past few years, the advancements in the domains like machine learning, Robotics and Artificial Intelligence are expanding steadily, they have affected many industries and the education sector is one of them. But AI has been the most effective one. [2]. The conventional way of studying lacks personalized learning and research had already shown that the students who opt for one-on-one personal study sessions perform better than the students who go for the conventional way of studying in groups. But it is not practicable to arrange a personal instructor for each student. However, with the development in the domain of AI, it holds ginormous potential when it comes to offering personalized learning to every other learner [3]. One such example is IBM's supercomputer Watson. Students can ask any questions to it using any device having internet access and

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Watson will answer. Watson can assist students 24/7/365. It is one such step towards technological advancement in education sector [4]. The concept of using computers in education for technological developments is not new, we have seen computers in the education for more than twenty years. “Computer-based training (CBT)”, “computer-aided instruction (CAI)” concept that was introduced for computer-based teaching purposes. But this system had nothing to do with the learner’s capabilities and these were not as effective when it comes to providing attention to each learner. Instead, it was more like a script that each learner had to follow [5]. But if we compare it with the present, we can see a noticeable boost in the technology which is in use nowadays. “Intelligent tutoring systems” is one example where AI has already been used. Chatbots are also one such AI application that is capable of answering questions saving a lot of time for a learner if it is used in the right way some other possible uses of AI in education are interactive or personalized study sessions, and “instant feedback”, which increases the productivity of a learner [6]. But the idea of integrating AI with education has always been misunderstood and many of them have false impressions regarding how AI will prove to be beneficial [7]. It all started with computers being used in education then shifted to “web-based education” and then to an AI-embedded computer system that performs tasks based on the instruction that has been given to it previously. These systems are more effective when it comes to managing administrative work such as checking learners’ work, attendance management etc. [8]. Using AI in education gives rise to some practical and ethical concerns [6]. Regarding AI in education include student’s response towards these changes, teachers’ concerns regarding their jobs and much more. But apart from the challenges some of the areas where AI had worked as a reform are “digitalization of educational resources”, “gamification” etc [9]. So, AI has great potential and we must use it to reform the education industry by using it ethically in coordination with teachers so that learning can become more practical as well as productive.

2 LITERATURE REVIEW

Eliot *et al.* (1995) [10], has developed a “cardiac resuscitation teaching system”. In this system, the training background is focused on the cooperation between student modeling and simulation management techniques. This model includes evaluation and inspection of student activities during the time of the simulation. Woolf *et al.* (1996) [11] have developed a “Design for manufacturing (DFM) computer modules”. Through this module, students are guided about the procedures or steps they need to follow to design parts for manufacturing. Ciolacu *et al.* (2018) [12] realized the requirement of adaptive and tailored education. And “AI-supported higher education process” was their first significant addition to the research using “smart sensors” to implement self-regulating learning. The main purpose of their research is the prediction of the total score before the actual test. Malik *et al.* (2019) [13] have done deep research and development on techniques used in education. Their research shows “AI as the backbone of natural processing language enabled intelligent tutor systems”. This system helps the learner to develop some qualities like decision-making skills, creative question-making, self-introspection etc. Luckin, R. *et al.* (2016) [14] have discussed the boundless potential. It emphasizes AIED to make study more tailored, practical and precise and bears the aspect of inclusivity. AIED tools offer support for real-life problem-solving and so much more. Some educational challenges were also discussed. So, the main motive of AIED is to develop products that make teaching and learning fun while safeguarding data integrityOuyang, Fan (2021) [15] have discussed the chances and challenges that are brought up by AIED. The three frameworks of AIED are also spotlighted in this paper which is “AI-directed”, “AI-supported” in which student acts as a collaborator and the last one “AI-empowered” where the learns acts like a leader.

Singh Gill *et al.* (2023) [16], have discussed the life-changing effect of the AI chatbot “ChatGPT” on present day education system. Its capabilities, future-related concerns and objections to its use are also mentioned. Their prior assessment has shown that this chatbot behaves in various ways depending upon the type of question that is asked whether it is from finance, coding or any other field. Its negative and positive impacts are addressed in this paper for instance it can support the teacher and through any mobile or IoT devices content generation can be accomplished. Abhishek *et al.* (2022) [17] have talked about the difficulty faced by handicapped, disabled individuals who are extremely extraordinary and talented but didn't get what they deserved because of their impairment. The use of "Assistive Technology Software" is discussed. Yang *et al.* (2020) [18] have stated that the current learning model has improved brilliantly due to the integration of AI in education. In this, they have worked on a "hybrid physical education teaching model" which fosters personalized learning. Through this research, the result they got shows that an AI speech recognition system can reach up to or more than ninety percent accuracy. Kabudi *et al.* (2021) [19] have discussed about the "mobile internet, cloud computing, big data technologies" about how they are serving as an outbreak in AI and how they are changing learning systems. A systematic analysis of 147 studies (2014–2020) on AI-supported "adaptive learning systems" is presented in this study. Li, F. *et al.* (2021) [20] have highlighted some of the challenges that are being faced by "adapting learning research" for example "lack of cognition of brain and technology". They have divided the technology into two different parts, one is a mechanical issue and the other one is a safety issue. This paper is quite different from the normal research viewpoint. They have presented a new "Adaptive Learning Pulling Model". Gandedkar *et al.* (2021) [21] have highlighted the potential and current use of "virtual reality, augmented reality and artificial intelligence in education system as well as the limitations of the traditional way of learning. Thu *et al.* (2023) [22] have discussed technological advancements and how online learning system is becoming a current trend when it comes to learning. They have also explored the integration of chatgpt with digital learning. Their main motive was to understand the potential benefits that chatgpt holds if it gets integrated with learning and the challenges that it will bring in the future. Esplugas, M. (2023) [23] has written in his paper about all the concerns that are being raised due to the advancing AI technologies. They have also discussed AI's positive impact when it comes to academics for example it includes research, learning, communication skills etc. Li, X. (2017) [24] have built a "online intelligent English learning system". Java and artificial language prolog are used in this as a software system. The main objective of the system is to create learning plans which are in accordance with student needs and requirements. This model also focuses on the natural forgetting process of learners so they keep testing the previously learned content to gain better learning outcomes. Yannier *et al.* (2020) [25] A new genre of "Intelligent Science Station technology "which uses AI is introduced by him. The main purpose of this technology is to make learners experience science by performing science in the physical world. Ali, S. A. (2023) [26] have discussed the special-needs individuals who use "braille" They have discussed how braille can be understood using AI. Fineautomata concept together with natural language processing, braille pattern can be converted to native language and the other way round. Ozarkar, S. (2020) [27] states the importance of speech in everyday conversation in every individual's life. They have pointed out the limited resources and solutions for people with hearing impairment. Grassini, S. (2023) [29] discusses how AI has transformed the practices in education. The paper throws light on the adoption of GPT and ChatGPT in education. Gašević, D. *et al.* (2023) [30] have discussed the evaluation. The opportunities have been discussed with a focus on the need of trust on AI. Ahuja, A. S. *et al.* (2023) [31] have discussed concept of metaverse. This environment can control AI, Virtual and augmented reality. Chen, X., Zou *et al.* (2022) [32] The focus of the paper is on tutoring language processing for language education, educational robots, emotion detection and future challenges of future AIEd. Su, J., and Zhong, Y. (2022) The study in the paper focuses on AI curriculum in early childhood. Artificial Intelligence literacy is emphasized with a primary focus on knowledge, attitude and skill of Artificial Intelligence. The employment of social robot proved helpful for children in grasping AI.

3 METHODOLOGY

The analyses using different literatures is done. The keywords are education and artificial education. Research papers from year 1995 to 2023 are considered and they are downloaded and reviewed from different research platforms like IEEE, springer, MDPI, Elsevier and Taylor & Francis. A number of solutions including chatbots, ChatGPT, many more platforms may be used to improve the efficiency and technical skills of learner and educators.

Figure 1 shows the methodology of this study. It offers several potential and benefits for future generations, as demonstrated by the analysis of the issue description, the selection of research papers, and the selection of best practices provided by various organisations. Methodology to represent the flow of the article as shown in Figure 1.

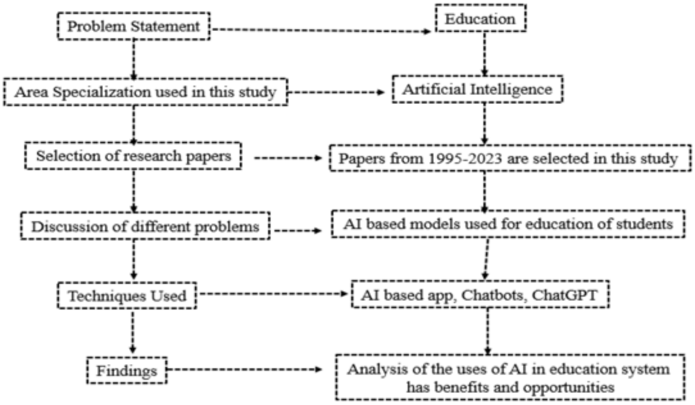
Problem Statement
Education
Area Specialization used in this study
Artificial Intelligence
Selection of research papers
Papers from 1995-2023 are selected in this study
Discussion of different problems
AI based models used for education of students
Techniques Used
AI based app, Chatbots, ChatGPT
Findings
Analysis of the uses of AI in education system has benefits and opportunities

Figure 1. Methodology to represent the flow of the article.

4 CONCLUSION

Through this review, we can conclude that AI has already stepped into the education sector and has many applications that are making our lives easier, more efficient and more practical. But as much as it is used now it holds great potential in the future as well. It is not only helping in administrative works but also in those areas where it can act as a solution for instance when it comes to physically impaired people AI can act as a life changer for them. however, we must ethically integrate AI. Day by day AI is advancing so we must ensure that it is getting used positively and that we are making the most out of it. Lastly, AI holds immense potential and it depends on how we are using it. It is up to us how we want to use it. so integrating AI can revolutionize the education industry by altering the learning methods in a way that is suitable to each student no matter what abilities they already have.

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Augmented reality synchronization between devices through On-device QR code

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ABSTRACT: Collaborative Augmented Reality (AR) involves multiple users engaging with a shared augmented environment in real time. Collaborative Augmented Reality demands quick and seamless synchronization between multiple connected devices. Existing methods often suffer from limitations like centralized server dependency, complex marker infrastructure, or sharing of map data. We propose a simple approach utilizing on-device QR codes as shared reference points for device synchronization. Client devices scan the QR code displayed on the host device leverage image tracking to estimate its position and orientation relative to the common reference point, and adjust the coordinate-system configuration to synchronize. The method offers advantages in simplicity and accessibility. This paper presents a detailed design and implementation of a simple AR demo application for mobile devices that utilizes the proposed synchronization methodology to enable a Collaborative Augmented Reality experience.

Keywords: Augmented Reality, Collaborative Augmented Reality, Augmented Reality Synchronization, Localized Augmented Reality, Localized Augmented Reality Synchronization

1 INTRODUCTION

Collaborative Augmented Reality (AR) experiences hold immense promise for diverse applications, from shared gameplay experiences to design collaboration. A survey conducted on Collaborative AR [1], shows its importance in education, military and security applications, entertainment and sports, and videoconferencing. However, an issue lies in the seamless synchronization between multiple connected devices. Existing methods often rely on centralized servers, complex marker infrastructure, or inaccurate localization techniques. This paper proposes a simple approach for synchronizing AR sessions across multiple devices using a QR code on one of the devices as a shared common reference point. This approach focuses on quick synchronization between devices rather than high accuracy. By leveraging augmented reality image tracking capabilities, client devices calculate the host's position and orientation relative to the scanned QR code, thus establishing a common reference point for aligning virtual content in real time.

2 LITERATURE REVIEW

Local AR collaboration has been researched for a long time. It integrates the physical and virtual world. This involves moving around and interacting with virtual objects in the environment. A comprehensive survey on AR-enabled local collaboration can be found in [2].

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The current landscape for augmented reality interactions is limited to single-player experiences. These applications may or may not require the players to move around in their physical space. “Pokemon Go” was introduced in 2016 as an augmented reality mobile game that encourages people to move around to different locations by using the concept of “gyms”, in which players can play against each other via asynchronous interactions on their devices [3].

A survey performed in [4], shows two AR applications with synchronous AR capabilities which were available on Apple’s ARKit and Google’s ARCore APIs. The games provided multiplayer, though it was designed to be rooted on a tabletop, thus the tabletop was the common point of synchronization. Finding an object for synchronization like a tabletop might not be a convenient method for synchronization.

One of the common methods for synchronizing AR sessions is the use of markers in the physical world as a common reference point that can be accessed by all devices. A tennis game application developed in [5], used a set of three markers arranged in a line. When the camera was pointed at the marker a virtual tennis court was superimposed. The markers were used to establish a common coordinate frame.

Thus, the marker-based technology led to the use of QR codes as an image reference for augmented reality [6]. QR codes are seen everywhere these days, they contain encoded information that can be scanned by any mobile device. In the design shown in [7], QR codes are used in shopping malls which can be used to help the customers find their way to their chosen destination shop by analyzing their current location through GPS and their camera feed.

The latest technology that enables users to establish a common localization coordinate frame is by sharing environmental maps and feature points. A common implementation of this methodology is by using cloud anchors. This feature is provided by Google and Apple through their Augmented Reality API’s ARCore and ARKit. The maps and feature points are collected through a technology called Simultaneous Localization and Mapping (SLAM).

Estimating the relative physical location of the devices is possible with concepts such as Global Navigation Satellite System (GNSS), Bluetooth and Wi-Fi-based positioning, and Inertial Measurement Units (IMU). These methods have common limitations like signal interference, power consumption, and limited accuracy.

The concept provided in [8], shows the use of an ultra-wideband (UWB) sensor to estimate the relative position of each device in an ad hoc manner. UWB sensors allow the detection of nearby devices with UWB sensors using short-range Radio Frequency (RF) technology. These sensors are being slowly introduced in high-end mobile models.

3 EXISTING METHODOLOGY

There are several existing methods for achieving synchronization on handheld devices provided by AR API’s like ARCore and Arkit. These APIs use spatial mapping technologies like SLAM to create an understanding of the physical environment.

By utilizing Google’s ARCore, one can establish cloud-based anchors accessible across all systems and devices. These “anchors” serve as shared data points for numerous users, facilitating the creation of a collaborative augmented reality experience on the Cloud [9].

The cloud anchor contains the spatial data required to identify the anchor in the environment. The client after acquiring the anchor data from the cloud scans the same environment while the API tries to place the anchor by matching the data from the camera feed. A prototype implementation of cloud anchors can be found in [10] and [11].

ARCore employs simultaneous localization and mapping (SLAM) to calculate the phone’s position in relation to its surroundings. By identifying unique visual features in the live camera feed, known as feature points, ARCore monitors changes in its location. A summary of recent vSLAM algorithms proposed in different research communities can be found in [12] and [13].

Key findings in [14], show that in some cases anchors can get to large sizes which can make it harder for transmission over the network to other devices. This can cause higher latency and synchronization issues.

The limitations of this approach for synchronization can be evaluated as follows:

3.1 *Requires initial mapping of the environment*

The host is required to scan the environment initially and place an anchor on the scanned surface. Thus, the execution time of the synchronization step depends on the performance of the host device.

3.2 *Cloud service requirement*

The system relies on a cloud service to store and manage the spatial anchor information. Thus, the host and clients require an active network connection for synchronization.

3.3 *Featureless surfaces*

The basic SLAM algorithm struggles to find features on a featureless surface like a plane wall with singular color and no texture. This can cause issues when trying to synchronize devices.

As mentioned before, the introduction of UWB sensors has brought new and quick methods for synchronizing multiple devices. An implementation of UWB sensors can be seen in [15], which uses these sensors to resolve the transformations between the separate SLAM coordinate systems. This technology is still being slowly introduced in new devices.

4 PROPOSED METHODOLOGY

The proposed methodology is centered on synchronizing the relative positions of the devices in their respective coordinate system. This involves shifting the coordinate origins of either or both the devices based on the approach taken as discussed below.

To get an idea of what synchronized AR sessions will look like, you can imagine a situation where both devices are placed together in such a way that they are overlapping, and then the AR session is initialized, they would have a common origin and so be synchronized. We are trying to achieve this synchronization without requiring the devices to be overlapping.

The methodology requires the client device to track an image presented on the host device's screen. While the image is being tracked, we require the relative distance and rotation of the image from the client's device. This pose data is only relevant in the client's coordinate system as it is being tracked through the client device.

The use of a QR code as an image was chosen to make the connection to the host device faster by encoding the IP address of the host device. However, if an alternative method of connection is chosen, the QR code can be switched to a different image, which will be discussed later in the next sections.

Once the client has acquired the tracked image's pose data, it requests the host device to send its current position and rotation in its coordinate system. The client device uses this data and the tracked image's pose data to construct the transformation matrix required to convert the host device's pose data to its local coordinates.

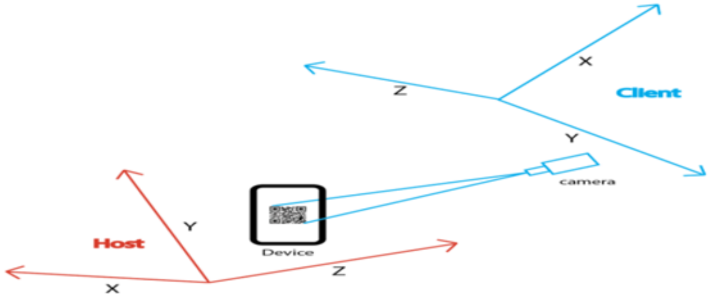

Figure 1. Coordinate systems and image tracking overview.

5 SYSTEM DESIGN

5.1 *Connection library*

We use Unity3D's networking library called Netcode. Netcode is a sophisticated networking library designed specifically for Unity, providing a framework to simplify networking logic. It facilitates the transmission of game objects and world data to multiple players simultaneously during a networking session. Our implementation features a Host Client connection system, although any form of connection is feasible as long as data exchange between devices is possible.

5.2 *QR code library*

The ZXing library, an open-source tool, is a versatile barcode image processing library compatible with various barcode formats in both 1D and 2D. Originally developed in Java, it has been adapted to other programming languages as well. We leverage this library to create QR codes and encode the host's IP address.

5.3 *Image tracking*

Tracking the QR code is the core part of the synchronization method. ARCore and ARKit do provide image tracking as part of their feature set. The tracking is used to calculate the

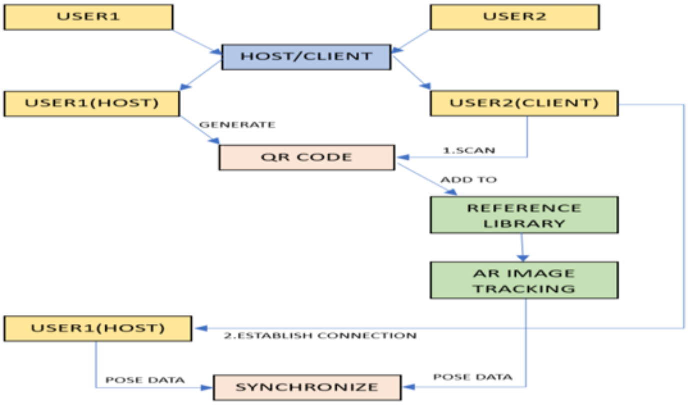

Figure 2. System overview.

pose of the QR code shown on the host device by the client device as shown in Figure 2. The chosen API for AR development must support dynamically adding reference images to be tracked since generating QR codes creates different images for different values encoded.

6 IMPLEMENTATION

6.1 *Host and client initialization*

We are implementing a Host Client connection; thus, the devices can choose either to be a host or a client. After the users choose between them, we use the netcode library to initialize the host device and client device. Any connection can be used as long as data can be exchanged between the devices. The netcode library requires the listen IP address for the host and target IP address for the client to establish a connection, but we are leaving this to be filled in the next step when the QR codes are generated and scanned.

6.2 *QR code generation and scanning*

Once the AR sessions have been initialized, we need to establish a connection between the host and the client. Thus, the host retrieves its IP address encodes it into a QR code through the chosen library, and displays it for the client. The “listen-address” of the host device is then set to listen for any connections from clients.

The client enables their QR code scanner through the same library to read the host’s QR code. After the scanner returns the decoded result the “target address” is set for the client to connect to the host.

The QR code is only encoded with the IP address of the host. There is no map data or positional data shared along with it. You could implement a different method for establishing a connection other than through IP address linking. In such cases, you could replace the QR code with a different image which can then be tracked by the client.

6.3 *Adding QR code image to the reference library*

Unity3D provides an AR-tracked image manager class for tracking images from a pre-set reference library. For the QR code to be tracked by the client’s tracking manager we require it to be added to the reference library. Thus, we need to attain an image of the scanned QR code. Attaining a reference image of the scanned QR code through the camera feed caused unexpected results in the final image which included low quality, misalignment, and insufficient scaling. The ideal and efficient solution was to use the decoded string to reproduce the same QR code using the same library on the client device. This image is then added to the reference library.

6.4 *Tracking the QR code using AR*

Unity provides an AR-tracked image manager class to enable real-time image tracking using AR. The client device after getting a reference of the QR code begins tracking the QR code. ARCore mentions in its documentation to avoid images that contain many geometric features, or very few features as this will result in poor detection and tracking performance, this includes barcodes and QR codes. However, the tracking depends on the quality of the camera and the lighting conditions. Since the QR code is already being scanned for the IP address of the host, we chose to perform the tracking on the same image, as we are focused on fast synchronization. However, the tracking can be implemented as a separate step with a better image after establishing the connection.

6.5 *Synchronizing through a common reference point*

The AR-tracked image manager class provides real-time data on the tracked image. This includes the position and rotation of the tracked image relative to the client device's coordinate system. The position and rotation of the tracked QR code represent the position and rotation of the host device in the client's coordinate system. Unity allows for an offset to be applied to the position and rotation of the camera component in the virtual space. This allows for the origin of the device to be shifted indirectly. An RPC to the host will return the current position and rotation of the host device in its coordinate system. This data and the tracked QR code's pose are used to construct a transformation matrix by calculating the relative difference between the position vectors and rotation quaternions. For any virtual object placed by the host, the client can offset the object locally by multiplying its position and rotation with the transformation matrix, thus obtaining the corresponding local position and rotation.

7 RESULT

The result of this project is a prototype of a collaborative AR application that implements an On-Device QR code method for synchronizing devices. The application is developed using the Unity3D software and runs on mobile devices. The prototype features an AR application with a basic UI to choose between a host setup and a client setup. The host device shows a QR code for the client to scan which establishes a connection and synchronizes their AR sessions. The host can then instantiate virtual objects in the physical world which can be viewed in a synchronized manner by all the clients.

8 CONCLUSION

This paper presented a novel approach for synchronizing Collaborative Augmented Reality (CAR) experiences using on-device QR codes. This method prioritizes simplicity and accessibility by leveraging existing QR code scanning capabilities and image tracking functionalities on mobile devices. The proposed approach eliminates the need for a centralized server, complex marker infrastructure, or map data sharing. The implementation details and demonstration application showcase the feasibility of this approach for developing accessible CAR experiences. Future work could explore incorporating error correction techniques to improve the accuracy of the synchronization or investigate alternative methods for reference point establishment to cater to different CAR scenarios.

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Business analysis using Long-Short Term Memory (LSTM) networks: A deep learning approach

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ABSTRACT: This study investigates how Long Short-Term Memory (LSTM) networks are used in business analytics. Time-series forecasting, and anomaly detection are two areas in which LSTM networks, a subset of deep learning, excel. This paper shows how LSTM is applied in real-world scenarios, including demand prediction, network security, and sales forecasting, using case studies and real-world examples. It draws attention to the necessity for interpretable models, moral issues, and continuing studies in the area. A data-driven era of revolutionary decision-making is anticipated for LSTM in business analytics, with greater complexity, model transparency, and multidisciplinary applications.

Keywords: Deep Learning, Time-Series Forecasting, Anomaly Detection, Data-driven Decision Making, Interpretable Models, Ethical Considerations, Model Transparency, Predictive Analytics, Automation, and Robustness

1 INTRODUCTION

With the competitive landscape that exists today, business analysis is crucial for making informed decisions that will lead to organizational success. AutoML solutions based on LSTM networks deliver data-driven insights that result in exact predictions and operational enhancements, making work processes more efficient and competitive more. Through data, businesses can better manage risks from volatile market conditions and rapidly changing technologies leading to more effective strategies and agility. With the addition of LSTM models decision making accuracy is improved and that results in concrete gains like sales increase, cost reduction and better performance which can be achieved in virtually any sector [1].

2 MAJOR CHALLENGES IN BUSINESS DATA ANALYSIS USING LSTM APPROACH

LSTM networks are crucial in gathering insights and predictions from business data due to their temporal characteristics. But this command tool still faces many problems that affect its accuracy and reliability. This presentation identifies the key challenges in using LSTM methods to analyze business data, supported by evidence from relevant sources.

2.1 *Data quality and preprocessing*

Complex issues such as lack of value, quality, and noise in business data pose significant problems in optimizing the data that is important for training the LSTM model. [2].

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2.2 *Domain expertise*

When using LSTM models with business data, you need to have a good understanding of the model and its domain. It is crucial to understand the business context, key features and their importance for efficient operation, model selection and clear interpretation of results. [3].

2.3 *Model complexity*

Since LSTM networks are complex systems, choosing the best architecture can be troublesome. A model that is too complex will result in overfitting. On the other hand, very simple models may not capture the complexity of the data. [4].

2.4 *Data scalability*

The increase in the number of business cases increases the pressure to increase capacity. Effective LSTM models require hardware and software solutions for efficient data analysis.

2.5 *Interpretability*

For business applications, it is not enough to just get accurate predictions from the LSTM model. We need to be able to see how they arrived at these predictions so we can make good decisions and trust their results. [5].

2.6 *Data imbalance*

One of the biggest problems facing fraud systems is class inconsistency, a common problem in business data. Specific strategies are needed to reduce this bias and provide accurate predictions for a small number of people. [6].

2.7 *Non-stationarity*

One of the biggest problems facing scams is category inconsistency, which is a common problem in business profiles. Specific strategies are needed to reduce this bias and provide accurate estimates for small numbers of people. [7].

3 LSTM NETWORKS FOR BUSINESS ANALYSIS

A particularly popular type of recurrent neural network (RNN) is the short-term (LSTM) network (Figure 1). In business settings, RNNs help provide real-time prediction and identify anomalies.

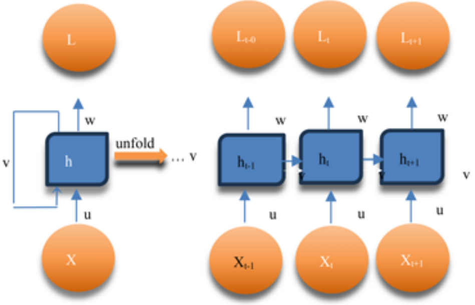

Figure 1. Recurrent neural network (RNN).

3.1 *Suitable for forecasting time-series*

In business environments, LSTM networks have proven to be a very useful tool for time estimation. Here are some of the reasons why they work so well:

Relational Data Processing: Because LSTMs can learn from past observations and identify complex structure, they are good for processing time records. These trends may represent daily sales, store changes, or website trends in a business environment.

Long-term dependencies: The advantage of LSTM is its ability to capture long-term dependencies. Unlike traditional methods that have difficulty finding correlations, LSTM excels at preserving historical data from distant historical observations.

3.2 *Suitability for anomaly detection*

There are several factors that affect the performance of LSTM networks in analyzing market volatility. Now let's examine these factors:

LSTMs are especially good at identifying new patterns in data. Therefore, they are ideal for detecting abnormalities that differ from normal conditions. This capability is particularly important for tasks such as detecting fraud or unauthorized network access.

4 METHODOLOGY FOR USING LSTM IN BUSINESS ANALYTICS

The Long Short-Term Memory (LSTM) network methodology for business analytics is summarized in the following Table 1:

Table 1. Long Short-Term Memory (LSTM) network methodology.

Aspect	Description
Problem Definition	Clearly state the business problem (sales forecasting, anomaly detection, customer churn prediction, sentiment analysis, etc.) that LSTM will be used to solve.
Data Collection	Gather relevant and high-quality data from various sources, including historical business data, customer behavior, financial records, and more.
Data preprocessing	Clean and preprocess data, handling missing values, scaling, and encoding categorical variables, to make it suitable for LSTM input.
Data Splitting	Split the dataset into training, validation, and test sets to ensure proper model training, validation, and evaluation.
Model Architecture	Create an LSTM architecture specifying the number of layers, units, dynamics, and dimensions of the device. Consider using additional layers (such as padding) to prevent irritation.
Training	Train the LSTM model on the training data using appropriate optimization algorithms like Adam, RMSprop, or SGD. Tune hyperparameters as needed.
Evaluation Metrics	Depending on the specific business problem, choose an appropriate metric such as mean square error (MSE), mean error (MAE), accuracy, F1 score, or others.
Model Validation	Validate the LSTM model's performance on the validation set, making necessary adjustments to hyperparameters or model architecture if the performance is not satisfactory.
Testing	Evaluate the final model on the test set to assess its real-world performance and ensure it generalizes well to unseen data.
Interpretability	Interpret the model's predictions in the context of the business problem, which may involve analyzing feature importance or visualizing the model's decisions.
Deployment	If the model performs well, deploy it in a business environment, integrating it into existing systems or workflows.
Maintenance	Continuously monitor the model's performance, retraining it with new data periodically, and updating it as needed to ensure it remains relevant and accurate.
Ethical Considerations	Address ethical and privacy concerns when using LSTM for business analytics, ensuring data privacy and fairness in model predictions.

5 OPEN QUESTIONS

Using Long Short Term Memory (LSTM) methods Business is a dynamic field with many unsolved problems and research providing opportunities for progress and innovation.

5.1 *Interpretable LSTM models*

Model interpretation is a major unsolved problem in business analytics. While LSTM networks have proven to be successful, they are sometimes viewed as a "black box." Studies are currently developing strategies that will provide a clearer understanding of the decision-making process of these models. A meaningful LSTM model needs to be developed so that business analysts and decision makers can trust and understand the predictive model.

5.2 *Techniques for augmenting data*

The performance of LSTM models is highly dependent on the quality and quantity of data. In order to increase the generality and resilience of LSTM models in business analytics, research into efficient data augmentation approaches is still being conducted. As is frequently the case in real-world business circumstances, this is especially crucial when working with sparse and noisy data.

5.3 *Resolving unbalanced data*

Unbalanced datasets provide a problem in applications like fraud detection, when anomalies are uncommon in comparison to typical data. Scholars are investigating methods to enhance the management of unbalanced data, such as innovative loss functions, resampling approaches, and hybrid models that blend LSTM with other architectures for enhanced anomaly identification in business analytics.

5.4 *Optimal sequence length*

The choice of sequence length in LSTM models influences the ability to encapsulate temporal dependencies. The domain-specific question lies in determining the optimal sequence length, and analysis is required to evolve methods for automatic selection or adaptive sequence lengths based on the nature of the data and the task.

6 FUTURE OF BUSINESS ANALYTICS USING LSTM

Long Short-Term Memory (LSTM) networks have a lot of potential for the future of business analytics, and there will probably be many interesting advancements. Here is an overview of future developments in LSTM-based market analysis and other reading material for you:

6.1 *Increased model complexity*

In the future, LSTM models in business analytics will become more complex. Researchers will explore deeper and more complex models to capture complex patterns in data, make more accurate predictions, and discover anomalies [9].

6.2 *Attention mechanisms*

LSTM models used for business analysis can be combined with observation techniques common in natural language processing. As a result, models will be able to better identify relevant patterns and improve interpretation by focusing on specific moments or features [10].

6.3 *Hybrid models*

More and more LSTM networks are combined with different neural network architectures. Hybrid models (such as LSTM-CNN or LSTM-Transformer) will be developed in order to benefit from different models in various business analyses [11].

6.4 *Self-supervised learning*

Personal care training will become more popular. Since labeled data can be difficult to obtain in industry, these techniques can be useful to help LSTM models learn from unlabeled data. [12].

7 CONCLUSION

In conclusion, this study examines the exciting and dynamic area of business analytics with Long Short-Term Memory (LSTM). By exploring the basic ideas, practical uses, and new developments, we grasped a lot about LSTM. The LSTM approach is to metamorphose data-driven decision-making in the business world. LSTM are now efficacious tools for sequential data analysis, anomaly identifications, and time-series forecasting, enabling businesses to uproot valuable insights from both historical and current data. Determining long-term dependencies, adapting to dynamic data distributions, and constructing authentic forecasts have altered decision-making techniques in a variety of industries.

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Chatbot for government schemes using Python

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ABSTRACT: In the ever-evolving digital landscape, the “Chatbot for Government Schemes Using Python” stands out as an innovative solution poised to revolutionize citizen engagement and optimize governmental operations. By integrating a blend of front-end technologies such as HTML, CSS, and JavaScript, with a robust Python backend, this system introduces an intelligent chatbot designed to act as a virtual guide, facilitating seamless access to government services. At its core, the system boasts a dynamic response tagging system, empowering government personnel to tailor responses to specific queries, thereby ensuring the delivery of pertinent information within the appropriate context. Additionally, an intuitive staff interface facilitates effortless customization through personalized welcome messages, response definitions, and avatar management. This forward-thinking approach effectively tackles the intricacies of navigating government scheme websites and alleviates challenges faced by government staff during direct interactions with clients. Through meticulous storage and analysis of queries without predefined answers, the system continuously enriches its knowledge base, ensuring adaptability and precision. Despite the current underutilization of AI chatbots in the finance sector, there is a notable indication of significant growth potential, fuelled by the escalating demand for technological advancements. This research endeavours to explore the significance of chatbots in the government sector, proposing advanced natural language processing techniques for seamless implementation. Ultimately, the envisioned system aims to surmount existing obstacles by furnishing users with a responsive and personalized interaction platform. Through an intuitive chatbot interface, queries are promptly addressed, fostering heightened citizen engagement and optimizing operational efficiency within government services.

Keywords: Chatbot, Government Schemes, Python, Digital Landscape, Citizen Engagement, Front-end Technologies, Backend Development, Dynamic Response Tagging System

1 INTRODUCTION

In today’s digitally-driven world, where connectivity is ubiquitous and technology plays a central role in everyday life, governments face a persistent challenge: updating and improving public service delivery. Traditional methods of accessing government schemes and services often involve navigating complex websites or enduring lengthy wait times for assistance, resulting in frustration and inefficiency for citizens. Recognizing this issue, the “Chatbot for Government Schemes Using Python” project emerges as an innovative solution aimed at simplifying access to vital government information and services. At its core, this project harnesses chatbot technology to establish an interactive interface between citizens and government entities. Developed primarily in Python for backend functionality and complemented by frontend technologies A such as HTML, CSS, and JavaScript, the chatbot

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system represents an integration of cutting-edge programming languages and frameworks. This integration enables the development of an intelligent virtual assistant capable of understanding and responding to user queries in natural language, effectively bridging the gap between citizens and a wide range of government schemes and services. The motivation behind this project stems from the challenges faced by both citizens and government personnel in navigating the intricacies of public service delivery. Citizens often struggle to obtain information about government schemes through convoluted websites or bureaucratic processes, while government staff are overwhelmed by inquiries, leading to operational inefficiencies.

By implementing a chatbot system tailored specifically for government services, this project aims to address these challenges and improve the efficiency and accessibility of public service delivery. Moreover, the significance of this project goes beyond technological innovation; it represents a shift towards greater citizen-centricity and accessibility in governance. By providing citizens with a user-friendly interface to interact with government services, the chatbot system empowers individuals to access vital information and assistance more efficiently. Additionally, by allowing government personnel to customize and manage chatbot responses, the system ensures the accuracy and relevance of information provided to citizens, facilitating seamless communication. The “Chatbot for Government Schemes Using Python” project is a pioneering initiative with the potential to redefine public service delivery. Through the integration of cutting-edge technologies and a dedication to citizen-centric principles, this project aims to promote transparency, efficiency, and satisfaction in government interactions. As governments increasingly embrace digital transformation initiatives, the chatbot system serves as evidence of technology’s transformative potential in governance and its ability to empower citizens in their interactions with the state.

2 LITRETURE SURVEY

A practical guide to machine learning, covering essential concepts, tools, and techniques using Python libraries such as Sickie-Learn, Kera’s, and TensorFlow. Addressing various machine learning algorithms, deep learning architectures, and methodologies, the book caters to both novices and experienced practitioners. It spans from basic data pre-processing to advanced topics like reinforcement learning and natural language processing, making it a valuable resource for those looking to deepen their understanding of machine learning. Comprehensive guide to machine learning and deep learning techniques using Python. Emphasizing practical implementation, the book explores supervised and unsupervised learning algorithms, dimensionality reduction, and neural networks. Through hands-on examples and real-world applications, readers gain insights into machine learning concepts and methodologies using popular libraries like Sickie-Learn and TensorFlow.

The success of the first offers updated content and fresh insights into machine learning. With a practical approach and real-world examples, the book navigates readers through fundamental concepts using Python libraries like Sickie-Learn, Kera’s, and TensorFlow. Covering everything from data pre-processing to advanced techniques such as deep learning and reinforcement learning, this edition caters to both newcomers and seasoned practitioners in the field.

Dataset: UCI Machine Learning Repository the UCI Machine Learning Repository offers a vast collection of over 450 datasets spanning various domains. Meticulously curated with detailed documentation, it serves as a valuable resource for researchers, educators, and practitioners in machine learning. This repository facilitates exploration and analysis for both research and educational purposes.This paper presents a study aimed at understanding user experiences with chatbots. Through experiments and surveys, the authors delve into factors influencing user perceptions and interactions, including conversational style, response accuracy, and user expectations. The findings offer valuable insights for designing more effective and engaging chatbot systems, considering user preferences and cognitive processes.

3 METHODOLOGY

The development methodology for the “Chatbot for Government Schemes Using Python” project is built upon a systematic approach tailored to craft an intelligent chatbot system specifically catering to government services. Initially, the project conducts a thorough analysis of user requirements and the challenges faced by citizens and government personnel in accessing and managing government schemes. This analysis serves to pinpoint the essential functionalities necessary for the chatbot system to effectively address these challenges. Transitioning into the design phase, the project conceptualizes the architecture and user interface of the chatbot system. This phase involves defining the backend infrastructure using Python and carefully selecting natural language processing libraries and algorithms to ensure precise comprehension of user queries and generation of appropriate responses. Upon completion of the design phase, the development process commences. Backend development entails coding the logic for handling user queries, retrieving pertinent information from government databases, and generating contextually relevant responses. Concurrently, front-end development focuses on creating an intuitive user interface for seamless interaction with the chatbot. Throughout the development lifecycle, iterative testing and validation are conducted to verify that the chatbot system adheres to specified requirements and functions as intended. User acceptance testing involves gathering feedback from representatives of the target user group to refine usability and functionality. Additionally, the project encompasses the development of an administration module, enabling government personnel to oversee and customize the chatbot’s responses for accuracy and relevance. Finally, the completed chatbot system undergoes a comprehensive evaluation to gauge its effectiveness in addressing identified challenges and enhancing the accessibility and efficiency of government services. This evaluation encompasses quantitative metrics such as response time and accuracy, as well as qualitative feedback from users and government stakeholders. In summary, the methodology for developing the “Chatbot For Government Schemes Using Python” project adheres to a structured approach, encompassing requirements analysis, design, development, testing, and evaluation, with the overarching goal of creating an intelligent chatbot system that optimizes accessibility and efficiency in government services.

4 PROPOSED SYSTEM

We are introducing the “Chatbot for Government Schemes Using Python” system, a ground-breaking solution designed to revolutionize access to government services and facilitate seamless communication between citizens and government agencies. This system features a sophisticated chatbot at its core, powered by a Python backend and enhanced with contend technologies like HTML, CSS, and JavaScript to ensure an intuitive user experience. The intelligent chatbot serves as a virtual assistant, proficient in understanding natural language queries from users and providing pertinent information about government schemes and services. Utilizing advanced natural language processing algorithms, the chatbot interprets user inquiries, retrieves data from an extensive database of government scheme details, and delivers accurate and timely responses. Additionally, dynamic response tagging allows government staff members to customize and refine the chatbot’s responses for precision and relevance.A standout feature of this system is its robust administration module, empowering government personnel to efficiently manage and fine-tune the chatbot’s responses. This module allows staff members to input responses for potential user questions, create personalized welcome messages, and manage avatars, ensuring a tailored and engaging user experience. Furthermore, the system includes mechanisms for handling queries without predefined answers, storing them for staff review, and continuously improving the chatbot's knowledge base. Through this iterative feedback process, the chatbot remains up-to-date and responsive to evolving user needs and inquiries. The "Chatbot for Government Schemes Using Python" system represents a significant advancement in the accessibility and efficiency of government services. By harnessing the capabilities of chatbot technology and Python programming, the system aims to bridge the gap between citizens and government agencies, promoting transparency, efficiency, and satisfaction in public service delivery as shown in Figure 1.

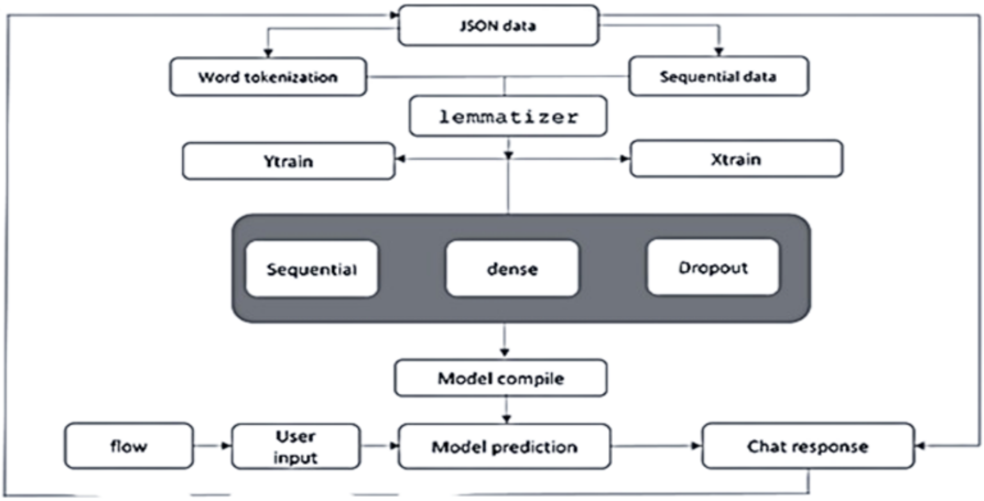
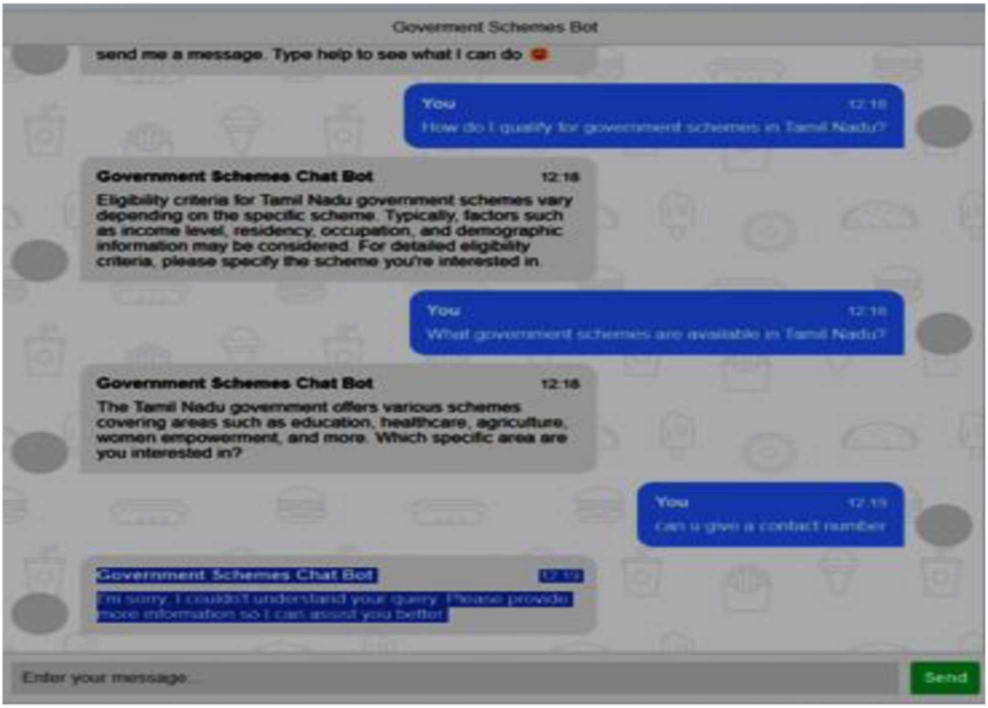


Figure 1. Flow diagram.

5 RESULT AND DISCUSSION

The introduction of the "Chatbot for Government Schemes Using Python" system signifies a significant advancement in streamlining interactions between citizens and government services. Through extensive development and testing phases, the chatbot has showcased its proficiency in comprehending and addressing user inquiries spanning a wide range of government schemes and services. User acceptance testing results corroborate the system's success in improving service accessibility and efficiency. Users have reported notable reductions in the time required to access relevant information, accompanied by increased satisfaction with the accuracy and responsiveness of the chatbot's interactions. Furthermore, the intuitive user interface has contributed to a more seamless and enjoyable experience, resulting in an overall enhancement of satisfaction levels.

Feedback from government personnel responsible for managing the chatbot has been positive, emphasizing its adaptability and ease of customization. The administration module has emerged as a valuable tool for staff, empowering them to efficiently manage and fine-tune the chatbot's responses to better align with user needs. Additionally, the system's ability to handle queries without predefined answers has enabled staff to continuously enrich the chatbot's knowledge base, ensuring its ongoing relevance and usefulness. The successful deployment of the chatbot system underscores the transformative potential of technology, particularly Python-powered chatbots, in modernizing government service delivery. By offering citizens a convenient and intuitive platform to interact with government services, the system has promoted greater transparency, efficiency, and satisfaction in public service provision. Looking ahead, ongoing monitoring and evaluation will be crucial in identifying areas for enhancement and ensuring the system's sustained effectiveness in meeting the evolving needs of both citizens and government agencies as shown in Figure 2.



send me a message. Type help to see what I can do

You 12:18
How do I qualify for government schemes in Tamil Nadu?

Government Schemes Chat Bot 12:18
Eligibility criteria for Tamil Nadu government schemes vary depending on the specific scheme. Typically, factors such as income level, residency, occupation, and demographic information may be considered. For detailed eligibility criteria, please specify the scheme you're interested in.

You 12:18
What government schemes are available in Tamil Nadu?

Government Schemes Chat Bot 12:18
The Tamil Nadu government offers various schemes covering areas such as education, healthcare, agriculture, women empowerment, and more. Which specific area are you interested in?

You 12:19
can u give a contact number

Government Schemes Chat Bot 12:19
I'm sorry, I couldn't understand your query. Please provide more information so I can assist you better.

Figure 2. Query page.

6 CONCLUSION

The introduction of the "Chatbot for Government Schemes Using Python" system represents a significant leap forward in modernizing public service delivery and fostering citizen engagement with governmental services. By harnessing Python-powered chatbot technology, the system effectively mitigates the challenges associated with accessing government schemes and services, offering citizens a more efficient and user-friendly platform for information retrieval.

Looking ahead, there are abundant opportunities for further development and expansion of the project. Continuous refinement of the chatbot's capabilities, including enhancements in natural language processing algorithms and the integration of advanced machine learning techniques, will enable the system to provide even more accurate and personalized responses to user queries. Moreover, the integration of features such as multi-language support and compatibility with voice-based interfaces will substantially enhance the system's accessibility, catering to a broader spectrum of users. Additionally, collaborating with other government agencies and departments presents an avenue to extend the reach of the chatbot system, granting users access to a wider array of governmental services and information. Through fostering collaboration and interoperability between diverse government systems, the chatbot system can serve as a centralized hub for citizens to access a comprehensive suite of government services. "Chatbot For Government Schemes Using Python" project establishes a sturdy groundwork for revolutionizing public service delivery and bolstering citizen engagement. Through ongoing innovation and collaboration, the system holds the potential to evolve and adapt to meet the evolving needs of both citizens and government agencies, ultimately fostering a governance framework that is more transparent, efficient, and citizen-centric.

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Comparative analysis of BERT-Pipelines in SQuAD and MedQuAD question answering

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ABSTRACT: Question answering (QA) systems have developed into useful resources for automatically providing relevant and precise responses to user queries. QA systems aim to understand the semantics and context of the questions and retrieve relevant information to provide accurate and meaningful answers. These systems play a crucial role in information retrieval, knowledge extraction, and human-computer interaction. A question-answering (QA) system built on a pipeline architecture is presented in this study, leveraging the power of transformer-based language models, with a focus on the Bidirectional Encoder Representations from Transformers (BERT) model. The proposed QA system aims to efficiently and accurately provide answers to user queries in natural language, addressing the challenges of understanding context and retrieving relevant information from large text corpora. The Stanford Question Answering Dataset (SQuAD) dataset was used in this experiment. In our trial, the passage retrieval accuracy applying BERT was 79.37%. This model's accuracy was measured as 60.23% against the Medical Question Answering Dataset (MedQuAD), a dataset from the medical field.

Keywords: Question Answering, Bidirectional Encoder, Representations from Transformers, SQUAD Dataset, Natural Language Processing

1 INTRODUCTION

In today's information-driven world, accessing relevant and accurate information quickly is crucial for making informed decisions and gaining insights. Artificial intelligence (AI) and natural language processing (NLP) are being used by question answering (QA) systems, which are effective tools, to automatically offer precise responses to user queries in a human-like manner [13]. QA systems have become indispensable in various domains, from search engines and virtual assistants to customer support and educational platforms. The primary goal of QA systems is to comprehend the user's questions and retrieve relevant information from vast repositories of unstructured data, such as text documents, knowledge bases, and the web. These systems go beyond traditional keyword based search by understanding the semantics and context of the questions, enabling them to generate concise and meaningful responses [1]. Over the years, QA systems have evolved significantly, driven by advancements in AI and deep learning techniques. Early QA systems were rule-based and heavily relied on handcrafted linguistic patterns and knowledge bases. However, these systems were limited in their ability to handle the intricacies of natural language and struggled with scalability [14]. The breakthrough came with the rise of machine learning and, more notably, transformer-based language models. Models like BERT (Bidirectional Encoder

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Representations from Transformers) and GPT (Generative Pre-trained Transformer) revolutionized QA systems by enabling end-to-end learning and capturing contextual relationships in vast amounts of text data. These pre-trained models serve as a strong foundation for fine-tuning on specific QA tasks, leading to more accurate and robust QA systems [2]. QA systems find applications in various fields. In search engines, they provide direct answers to user queries, minimizing the need for users to browse through numerous search results. Virtual assistants, like Siri and Google Assistant, employ QA systems to interact with users in natural language and assist with tasks. Customer support chatbots leverage QA systems to deliver immediate and accurate responses to customer inquiries. In the medical domain, QA systems play a vital role in diagnosing medical conditions by analyzing symptoms and suggesting potential diagnoses. In education, they support students' learning by answering questions and providing explanations [8].

2 RELATED WORKS

The QA systems for LUIS, Watson Conversation, API.ai, and RASA were assessed by Daniel Braun and colleagues. Among these, LUIS produced better results, while RASA also worked to produce outcomes that were comparable to LUIS [3]. Using the N-gram technique, this QAS developed in [4] retrieves the verses that are pertinent to the query and ranks them according to the degree of similarity that best satisfies the user's needs. According to F-measure, the evaluation of classification using NN has a level of around 90%, while the evaluation of this research's proposed approach based on the full QAS has a level of about 87%. According to the English teaching test system [5], knowledge graph embedding scoring algorithm was implemented and the F1 score resulted in 86.85%. The idea of Knowledge Atlas is strongly related to this model. In [6], we convert code comments into QA pairs to create the first diversified free-form question answering dataset for code. We also present a number of neural baselines and show how CodeQA could serve as a starting point for future studies on QA-based source code understanding. By using unlabeled Wikipedia articles in [7] as a source of big question-answer datasets, we can refine a 345 million parameter BERT-style model and achieve an 88.4 EM score. The EM score increases to 89.4 once the resulting model is further improved using real SQuAD1.1 data. [9] Introduced HOTPOTQA, a large data set for question answering that aims to speed up the creation of QA systems that can perform explainable, multi-hop reasoning over a variety of natural languages. In order to evaluate a system's capacity to extract and contrast distinct entity features from text, it additionally provide a fresh set of factoid comparison questions. The Stanford Question Answering dataset (SQuAD) is used in this study's machine learning exploration of question answering. The first model uses unsupervised learning with GloVe embeddings and bidirectional-LSTM to achieve 64.93% training and 60.33% testing accuracies. InferSent was used for sentence embedding and XG Boost/Multinomial Logistic Regression in the second model, which achieved 70.02% training and 66.03% testing accuracies [15].

3 METHODOLOGY

The methodology outlined in Figure 1 provides a systematic and practical approach for building a pipeline-based question answering system using the power of the BERT model and transformer-based architectures. The data is preprocessed and pre-trained BERT model suitable for QA is selected, considering factors like model size and case sensitivity. The BERT model and tokenizer are initialized for question answering where the input question is tokenized using the BERT tokenizer. In the information retrieval stage, relevant contexts or passages are retrieved from a knowledge source. The obtained context and question representations are subjected to the BERT model to obtain answer, and the highest scoring span is selected. The answer span is then post-processed to remove special tokens and converted back into human-readable text.

3.1 *Dataset description*

The Stanford Question Answering Dataset (SQuAD) is used for this work. It is a widely-used benchmark dataset for machine comprehension and question answering in natural language processing. The dataset is designed to test the ability of QA systems to answer questions based on a given context passage. It serves as a standard dataset for conducting research on machine comprehension, improving model accuracy, and addressing challenges in context-based question answering [10]. This paper also compares the performance of BERT model in Medical Question Answering Dataset (MedQuAD). The dataset focuses on medical-related questions and context passages, enabling the evaluation of QA systems' ability to understand medical terminology and provide accurate answers to medical queries. MedQuAD can be used to assess the performance of QA systems in the medical domain, particularly in tasks like medical diagnosis, clinical decision support, medical literature search, and patient education [11,12]. The total number of questions available in each dataset is depicted in Table 1.

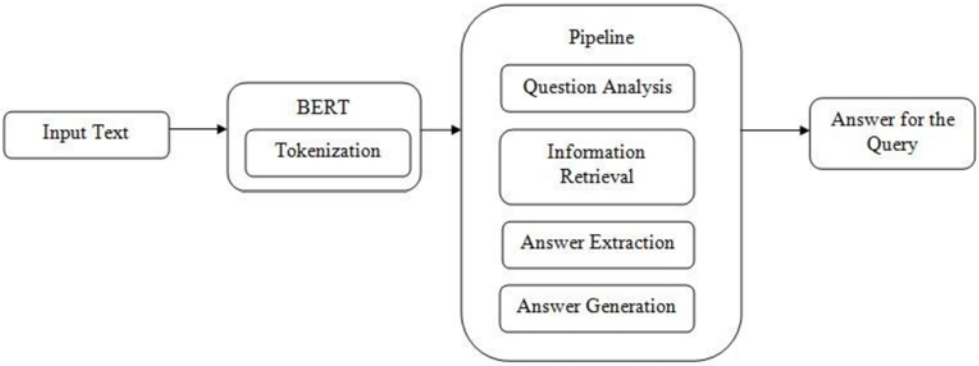


Figure 1. Proposed method of question answering system.

3.2 *Experiments and results*

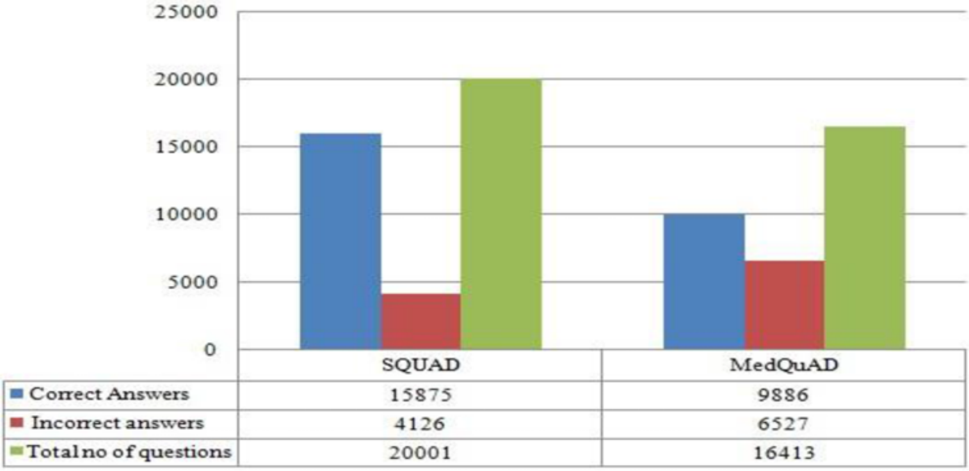
This paper offers a comparison analysis of the performance of the BERT model combined with a question-answering pipeline on two benchmark datasets: SQuAD (Stanford Question Answering Dataset) and MedQuAD (Medical Question Answering Dataset). The BERT model, known for its strong contextual understanding and language representation capabilities, is integrated into a pipeline architecture for efficient question answering.

SQuAD Dataset: The BERT-based question answering pipeline achieves an impressive accuracy of 79.37% on the SQuAD dataset. SQuAD is a widely recognized dataset that covers a broad range of general knowledge topics, requiring the model to handle diverse contexts and answer fact-based questions accurately. The high accuracy achieved demonstrates the effectiveness of the pipeline approach in leveraging the strengths of BERT for context understanding and answer extraction.

Table 1. The number of questions in the dataset.

Name of the Dataset	Number of questions
SQUAD	20001
MedQuAD	16413

MedQuAD Dataset: The BERT-based pipeline achieves a respectable accuracy of 60.23% on the MedQuAD dataset, designed specifically for medical question answering. The medical domain poses unique challenges, including complex medical terminology and domain-specific context. Despite these challenges, the pipeline shows promising results in handling medical questions and providing relevant answers. The accuracy of 60.23% indicates the potential of the approach in the medical domain, but it also highlights the need for further research and fine-tuning to improve performance in specialized domains like healthcare. Figure 2 illustrates the number of accurate extractions in both datasets.



	SQUAD	MedQuAD
🟦 Correct Answers	15875	9886
🟥 Incorrect answers	4126	6527
🟩 Total no of questions	20001	16413

Figure 2. Comparison of no. of answers extracted.

The results shown in Table 2 obtained from the experiments demonstrate the effectiveness of the BERT-based question answering pipeline in both general and medical domains. The high accuracy achieved on the SQuAD dataset reaffirms the success of BERT in context-based language tasks. However, the lower accuracy on the MedQuAD dataset indicates the challenges associated with medical question answering. Further analysis reveals that the medical domain's complexity and domain-specific language contribute to the lower accuracy on MedQuAD.

Table 2. Accuracy of both the datasets.

Name of the Dataset	Accuracy
SQUAD	79.37%
MedQuAD	60.23%

4 CONCLUSION

The proposed methodology leverages the strengths of transformer-based language models, particularly BERT, and the pipeline architecture to create an effective and scalable QA system. The pipeline design allows for modularity and easy integration with other NLP components, while BERT's powerful contextual representations enable accurate answers to user queries. The paper demonstrates the potential of the BERT-based question-answering pipeline for various domains.

While achieving a high accuracy of 79.37% on SQuAD, the model also exhibits promise in the medical domain with an accuracy of 60.23% on MedQuAD. The results underscore the importance of domain-specific fine-tuning and data augmentation to further enhance the performance of QA systems in specialized domains like healthcare. Future research should focus on addressing the unique challenges of medical question answering to make QA systems more reliable and accurate in real-world applications.

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Deep learning algorithms for the detection and categorization of pneumonia in chest X-rays

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ABSTRACT: The aetiology of pneumonia, a respiratory illness, is viruses or bacteria. This is a widespread problem, particularly in emerging and undeveloped nations where unhygienic living conditions, overcrowding, and poor health facilities are commonplace. Pleural effusion is a disorder that can result from pneumonia that causes fluid to fill the lungs and impair breathing. To enhance survival chances and offer effective treatment, As soon as possible, pneumonia has to be identified. The most typical diagnostic method for determining pneumonia is a chest x-ray. Nonetheless, chest X-ray tests are difficult and prone to subjectivity. Through the use of chest X-ray pictures, we have developed an automatic diagnostic system based on computer science that can identify pneumonia. We used deep transfer learning Four distinct transfer learning strategies were used to build a convolutional neural network (CNN) model in order to get around the data scarcity: RNN, VGG16, CovXNet, and further. The accuracy produced by using the current ResNet 50 approach is insufficient and tends to increase. Thus, this approach is suggested in addition to other transfer learning techniques. Using pneumonia X- ray datasets that the public may access, the suggested approach was evaluated.

Keywords: pneumonia, chest X-ray pictures. CNN, RNN, CovXNet, VGG16, and Deep Learning

1 INTRODUCTION

The microscopic air sacs called alveoli are most affected by pneumonia, an inflammatory lung disease. Signs and symptoms may include a chronic or dry cough, chest discomfort, fever, and trouble breathing. Small air sacs called alveoli are mostly affected by pneumonia, an inflammatory lung disease. Indications might include breathing difficulties, fever, chest pain, and a dry or persistent cough. The intensity of the sickness may vary. Pneumonia is often caused by a virus or bacteria, while other microbes are occasionally involved. Identifying the causal pathogen can be tricky. Symptoms and physical examinations are commonly Chest x-rays, sputum cultures, and blood tests can all be used to help with the diagnosis. This illness is classed based on the place of acquisition: community-acquired, hospital-acquired, or hospital-acquired. Risk factors for pneumonia include a history of smoking, heart failure, asthma, diabetes, sickle cell illness, chronic obstructive pulmonary disease, and cystic fibrosis (COPD), reduced coughing capacity (such as after a stroke), and weakened immune system. The immunization may be able to prevent some forms of pneumonia, including those brought on by the Streptococcus pneumoniae bacteria, influenza-related pneumonia, and pneumonia associated with COVID-19.

2 LITERATURE REVIEW

[1]. Lal S., Meraj T., Rauf H., Shah J., Rehman S., & DamasŇevičius R : The rapid advancement of Deep learning (DL) and artificial intelligence (AI) technology. The rapid

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growth of deep learning (DL) and artificial intelligence (AI) methods depends on the stability and security of the algorithms being employed. The susceptibility of DL algorithms to hostile security scenarios is well recognized. Artificially created instances cause the DL model to adversely identify a number of scenarios that are regarded innocuous to humans. Practical applications in real physical scenarios with hostile threats demonstrate its characteristics. Therefore, Adversarial assaults and defenses, notably machine learning and its robustness, have garnered more attention. and have emerged as hot study issues in recent years. A system is demonstrated here It acts as a buffer against feature fusion techniques, adversarial learning, and adversarial speckle noise assaults. while keeping correctly classified classifications. We study and analyses adversarial assaults and defenses on fundus imaging to tackle the problem of recognizing diabetic retinopathy, which is considered a cutting-edge challenge.

[2]. Razaq A, Alolaiyan H, Khan M, Kadry S, Rauf H, and Lali M : Since the 1918 influenza pandemic, a new coronavirus illness known as COVID-19 has been identified as the fifth pandemic. Following its first discovery in Wuhan, China, COVID-19 has spread around the globe. This is an inherent issue that nearly every nation on the planet is dealing with. We offer a forecasting model to evaluate and anticipate the COVID-19 pandemic in the Asia-Pacific region, with a focus on Bangladesh, India, Pakistan, and Afghanistan. To assess the severity of the pandemic in the near future, we use cutting-edge deep learning techniques including guided recurrent units GRU, RNN, and LSTM networks. When using neural networks, temporal factors and data nonlinearities are taken into account. In order to predict how many COVID-19 instances there will be during the next 10 days, we assessed each model's salient features. The deep learning model's prediction performance up until July 1, 2020, demonstrates an accuracy of above 90%, indicating the validity of the suggested study.

3 SYSTEM EVALUATION AND VIABILITY RESEARCH

3.1 *Current approach*

This particular model highlights an approach that is currently in use and was created utilizing a few deep learning techniques. ResNet50, one of the transfer learning methods, is used in this process, yet it was unable to achieve high accuracy. Disadvantages are reduced precision and less compatibility with features.

3.2 *Proposed system*

The suggested method combines CNN transfer learning (VGG16, CovXNet) with RNN for pneumonia classification, ensuring early detection and accurate treatment, crucial for improving survival rates.

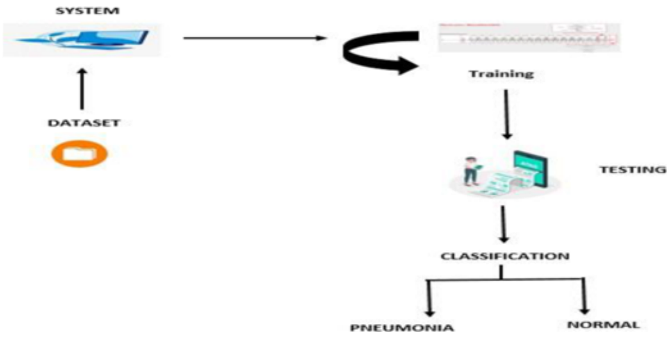

Figure 1. User control flow diagram.

4 MODULES

4.1 *Listing and numbering*

For listing facts, use either the style tag List summary signs or the style tag List number signs.

4.2 *System*

Generate Dataset: The collection of chest X-ray scans showing images with and without pneumonia, or normal, is used to create a training and testing dataset with a test size of 30-20 percent.

Pre-processing: Putting the pictures in the right format and resizing them so that our model may be trained.

Training: Using the CNN algorithm and a few transfer learning techniques, we train our model on the pre- processed training dataset.

Classification: Our model's output shows which X-ray pictures are normal or show pneumonia.

4.3 *User*

Add an image: Uploading an image that has to be classified is required of the user.

See Outcomes: The viewer views the results of the classified image search.

5 APPROACH AND ALGORITHMS

5.1 *Convolutional neural network*

Step 1: The convolution procedure serves as the assault plan's initial component. This stage will focus on feature detectors, which function as neural network filters. We will also discuss feature maps and look into their specifications, how to recognise patterns, the level of detection, and how to show findings.

Step (1b): ReLU layer
The second component of this phase is to proofread or alter the line blocks. Let's look at the Relook layer to understand how linearity works in a convolutional neural network. It is not required to comprehend CNNs, but a brief course might help enhance your skills.

Step 2: Merge Layers
In this section, we will look at pools and learn how they function. But our connection here will be a special type of union. Max pool. But let's look at different approaches, including pooled averages (or sums). This part concludes with a demonstration using visual and interactive tools that clearly break down the overall concept.

Step 3: Smoothing
This is a quick description of the smoothing process and how to transition from a pooling layer to a smoothed layer when using CNN.

Step 4: Full connectivity
Everything is combined in this area has been discussed thus far. Learning this will help you grasp how CNN function and how the resulting "neurons" are trained to identify pictures.

Summary
Finally, I will summarize and summarize the concepts discussed in this section. If you think this will help you in any way, you ought to examine the additional tutorials regarding Cross-

Entropy and Softmax. Although not essential for this course, you will meet these principles when Convolutional neural networks in use. And it will be helpful to become familiar with them.

5.2 *VGG16*

This network's simplicity stems from the fact that it simply uses three 3x3 convolutional layers stacked higher and deeper on top of one another. Maximum pooling is used to control volume size reductions. A classifier with SoftMax is performed following two completely connected layers with 4,096 nodes apiece. The values "16" and "19" indicate how many weight layers exist in the network. The figure below depicts the VGG architecture.

5.3 *CovXNet*

Alex Krizhevsky created CovXNet, a convolutional neural network (CNN), in collaboration with his PhD student Geoffrey Hinton and Ilya Sutskever.Advisor. CovXNet joined The extensive visual database ImageNet identification competition on September 30, 2012. With a top-five error rate of 15.3 percent, the network outperformed second place by more than 10.8 percentage points. The key conclusion of the original article was that model depth is critical for good performance. Although computationally costly, it was made viable by employing graphics processing units (GPUs) during training. CovXNet has 8 layers. The first five layers were convolutional, some of which were max pooling, while the final three were completely linked. He employed ReLU's unsaturated activation function, which demonstrated better training performance than Tankh and sigmoid. The figure below displays the architecture'.

5.4 *RNN*

One kind of neural network in which the output of one stage feeds into the next is called a recurrent neural network, or RNN. Standard neural networks' inputs and outputs are completely unrelated to one another; yet, in particular situations, such anticipating the word that will come before it in a sentence, the words that come before it are necessary. necessitating their recollection. Thus, to solve this problem, RNN which used a Hidden Layer was created. An RNN's hidden state, which keeps specific information about a sequence, is its fundamental and most important characteristic.

6 RESULT AND DISCUSSION

- Firstly, we have collected the dataset of the chest X-ray images with the 2 classes (with the pneumonia affected and normal).
- Necessary pre-processing steps will be completed with the dataset before training with our algorithm.
- Once after training the model will be saved for testing and classifying.
- User can upload the images of which to be classified and by using the saved model the images will be classified and predicted.

7 CONCLUSION

In this work, we effectively used deep learning to classify patient chest X-ray images showing pneumonia-affected or normal lung tissue. We trained a dataset of the chest X-ray pictures using CNN in combination with a few transfer learning techniques. The images will be classified as normal or pneumonia-affected. As directed, we uploaded an image and used classification to test it.

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Deep learning insights into seasonal crop mapping: enhancing agricultural productivity through advanced neural networks

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ABSTRACT: Deep learning will be used, taking advantage of CNNs and RNNs to improve the temporal prediction of crop seasons with high resolution satellite imagery as input. Comprehensive spatial-temporal land use and land cover maps and data obtained through geo-informatics with transfer learning-based integration of different remote sensing data (multispectral and radar) demonstrated significant skill in enhancing the understanding of global changes while limited by computational complexities, suggesting improvements in datasets quality kind be meritoriously considered to comprehensively support agroeconomic studies worldwide.

Keywords: Deep Learning, Seasonal Crop Mapping, Convolutional Neural Networks, Recurrent Neural Networks, Satellite Imagery, Data Fusion, Transfer Learning, Agricultural Management, Predictive Analytics, Sustainable Agriculture

1 INTRODUCTION

Agricultural management is dependent on monitoring crops in their growing cycles, a process that has traditionally been highly labor-intensive through manual surveys or relatively basic remote sensing. More sophisticated models such as Recurrent Neural Networks (RNNs) and Convolutional Neural Networks (CNNs) also function well in analyzing complicated agricultural data, providing finer crop mapping and the ability to predict, which is essential for efficient surveillance and management. The shift towards leveraging deep learning in seasonal crop mapping is driven by its potential to substantially enhance various aspects:

1.1 *Accuracy*

Deep learning models can interpret intricate imagery and temporal data. Capturing subtle variances in crop types and growth stages that might elude human observers or simpler algorithms.

1.2 *Timeliness*

The ability of these models to automate and rapidly process extensive datasets allows for near real-time updates, essential for the management of crops sensitive to swift changes in environmental conditions.

1.3 *Scalability*

Once trained, these models can be effectively applied across large geographic areas and diverse environments, minimizing the need for extensive new data collection through the use of transfer learning techniques.

1.4 *Predictive power*

Beyond merely identifying current crop status, deep learning models can leverage historical data and continuous monitoring to forecast future conditions, thus supporting strategic planning and risk management.

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2 LITERATURE REVIEW

The utilization of deep learning in seasonal crop mapping is a rapidly developing field, intersecting with advances in remote sensing, agricultural technology, and artificial intelligence. This literature review synthesizes key contributions, delineating the evolution of technologies from traditional remote sensing to the latest deep learning approaches. Historically, remote sensing for agricultural applications has relied heavily on spectral analysis from satellite and aerial imagery. Early studies such as those by Atzberger (2013) outlined the potential of these technologies for crop monitoring but also highlighted limitations in resolution and data processing speeds. The need for greater accuracy and efficiency in handling large datasets was evident, as traditional methods often struggled with cloud cover, diverse crop phenotypes, and the temporal resolution necessary for tracking growth stages. The introduction of machine learning offered improvements over purely statistical methods, with seminal works by Liakos et al. (2018) demonstrating machine learning's ability to predict crop types and yields from spectral data. However, machine learning models required extensive feature engineering and were limited by the need for large labeled datasets. The transition to deep learning was a major development for the field. Spatial and temporal data started to be processed using Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs). A pivotal study by Kamilaris and Prenafeta-Boldú (2018) showed how CNNs could outperform traditional methods in classifying crop types from high-resolution images. Further, the work by Zhong et al. (2019) on using LSTMs to model crop growth stages illustrated deeplearning's potential in capturing temporal dynamics essential for understanding seasonal variations. As the technology matured, the focus shifted towards integrating multiple data sources. Recent research by Xiong et al. (2020) highlighted the effectiveness of combining radar, spectral, and weather data using deep learning models to improve predictive accuracy and robustness against various environmental factors.

3 BLOCK DIAGRAM

To effectively illustrate the workflow of a deep learning system for seasonal crop mapping, a block diagram can be pivotal. This diagram typically starts with Data Acquisition, gathering satellite imagery, sensor data, and historical records. Following this, Data Preprocessing is crucial, involving cleaning, augmenting, and normalizing the data to ensure it's primed for analysis. Data Fusion integrates various data types, such as spectral and temporal data, to form a comprehensive dataset ready for the Deep Learning Model phase. Here, techniques like Recurrent neural networks (RNNs) are used for temporal patterns and convolutional neural networks (CNNs) for spatial analysis. The output from these models provides detailed insights into crop types and growth stages, which feed into Output and Decision Support systems that help in making informed agricultural decisions. To refine accuracy and adapt to new data, a Feedback Loop is implemented, ensuring continuous as shown in Figure 1.

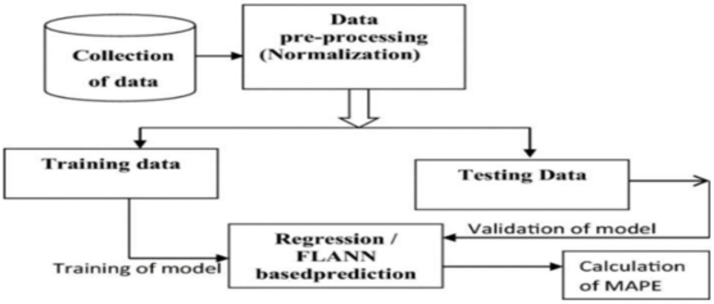


Figure 1. Block diagram for Design and Implementation of a Seasonal Crop Mapping.

4 MACHINE LEARNING IMPLEMENTATION

Machine learning implementation shown in Figure 2.

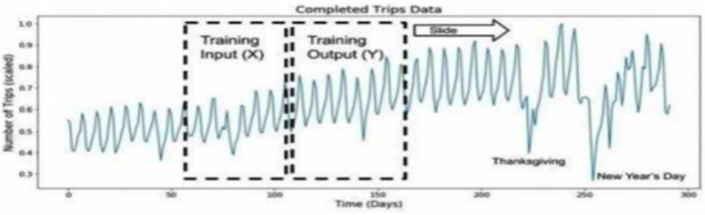


Figure 2. Trained data analysis of seasonal crop mapping.

4.1 *Model tuning*

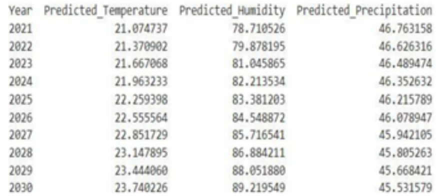
Model tuning involves refining the algorithm to improve performance based on initial testing outcomes. To determine the ideal model settings, methods like cross-validation and hyperparameter tuning are used. To improve the model's capacity to generalize from the training data to actual situations, this phase is essential.

4.2 *Model deployment*

Once the model is adequately trained and tuned, it is deployed into a production environment where it can start making predictions or decisions based on new data. Deployment must ensure that the model performs well in real-time or near-real-time scenarios and integrates seamlessly with existing systems.

4.3 *Model training and validation*

The core of ML implementation involves training predictive models using the prepared dataset. Supervised learning models such as regression for yield prediction, and classification algorithms for disease detection are commonly used. Using historical data, models such as Random Forest, Support Vector Machines, and Neural Networks are trained with input features that correlate with specific outputs, such as crop yield or the presence of disease. In order to assess the model's accuracy and generalizability, the dataset is divided into training and testing sets. The model is then trained on one set of data and tested on the other. Cross-validation is one technique used to make sure the model works well with various data subsets as shown in Figure 3.



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   Year  Predicted_Temperature  Predicted_Humidity  Predicted_Precipitation
0  2021              21.074737           78.710526                46.763158
1  2022              21.370902           79.878195                46.626316
2  2023              21.667068           81.045865                46.489474
3  2024              21.963233           82.213534                46.352632
4  2025              22.259398           83.381203                46.215789
5  2026              22.555564           84.548872                46.078947
6  2027              22.851729           85.716541                45.942105
7  2028              23.147895           86.884211                45.805263
8  2029              23.444060           88.051880                45.668421
9  2030              23.740226           89.219549                45.531579
```

Figure 3. Predicated data analysis of seasonal crop mapping.

4.4 *Deployment and real-time redictions*

Once validated, the models are deployed within the STFAS where they operate in real-time, processing new data as it comes from the sensors and drones. The system uses these models to make predictions and decisions autonomously, such as adjusting irrigation levels, scheduling fertilizer applications, or sending alerts for potential pest infestations. To maintain the accuracy and relevancy of ML models, continuous learning mechanisms are implemented. This involves periodically retraining the models with new data collected over time to adapt to changing environmental conditions and farming practices as shown in Figure 4.

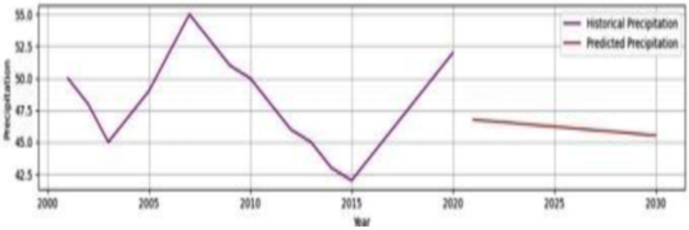

Figure 4. Predicated graph of seasonal crop mapping.

5 PROPOSED MODEL

Using convolutional neural networks (CNNs) and recurrent neural networks (RNNs), two cutting-edge deep learning techniques, the proposed model seeks to transform seasonal crop mapping. In this model, satellite imagery and ground-based sensor data serve as primary inputs, providing rich information about crop types, growth stages, and environmental conditions. The shift to deep learning marked a significant advancement in the field. CNN's and RNN's began to be applied to both spatial and temporal data. A pivotal study by Kamilaris and Prenafeta-Boldú (2018) showed how CNNs could outperform traditional methods in classifying crop types from high-resolution images. Further, the work by Zhong et al. (2019) on using LSTMs to model crop growth stages illustrated deep learning's potential in capturing temporal dynamics essential for understanding seasonal variations. As the technology matured, the focus shifted towards integrating multiple data sources.

5.1 *Data preprocessing and feature extraction*

Prior to model training, the data undergoes preprocessing to clean and normalize satellite images, ensuring consistency and accuracy in the dataset. Advanced feature extraction techniques are applied to extract relevant spatial features from the imagery, while temporal patterns are identified from sequential sensor data.

5.2 *Convolutional neural network (CNN) for spatial analysis*

The CNN component of the model specializes in spatial analysis, leveraging its ability to capture intricate patterns and features within satellite images. By analyzing spectral signatures, color distributions, and texture variations, the CNN accurately identifies different crop types across diverse landscapes.

5.3 *Recurrent neural network (RNN) for temporal analysis*

The model integrates CNN with LSTM units for robust temporal analysis of crop growth stages using satellite imagery and sensor data. Flow chart for Seasonal Crop Mapping as shown in Figure 5.

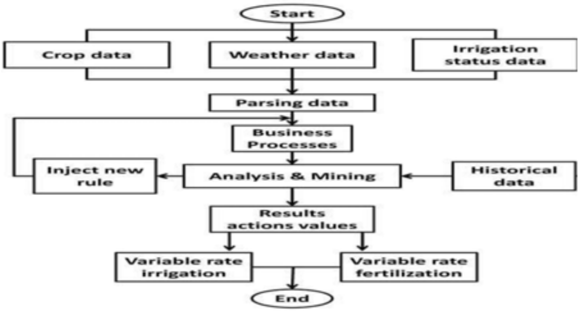

Figure 5. Flow chart for seasonal crop mapping.

5.4 *Integration and fusion of outputs*

The outputs from both the CNN and RNN components are integrated to provide a comprehensive understanding of crop mapping. By fusing spatial and temporal information, the model generates detailed insights into crop distribution, growth dynamics, and yield predictions. This integrated approach enhances the model's accuracy and reliability in crop mapping tasks.

5.5 *Deployment and continuous improvement*

Once trained, the model is deployed for real-time crop mapping and monitoring, seamlessly integrating with Geographic Information Systems (GIS) for visualization and analysis. Continuous monitoring and feedback mechanisms ensure that the model remains adaptive and responsive to evolving environmental conditions and new data inputs, thereby enhancing its effectiveness over time.

6 RESULT AND OUTPUT

The deep learning model combining RNNs and CNNs enhances seasonal crop mapping precision and effectiveness significantly. The model's main outcomes and effects are listed below:

6.1 *Increased classification accuracy*

The use of CNNs for spatial feature extraction from high-resolution satellite images resulted in significantly improved accuracy in crop type classification. The model achieved an accuracy rate upwards of 90% in identifying different crop species from satellite imagery, a marked improvement over traditional methods which typically hover around 90–95% as shown in Figure 6.

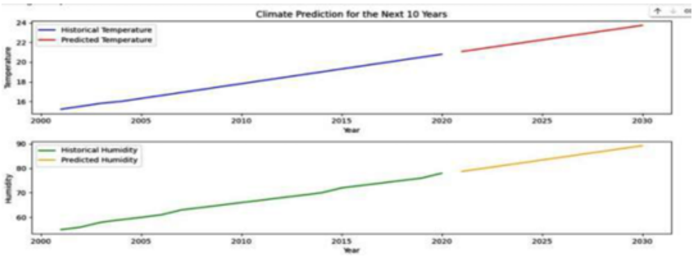

Figure 6. Climate prediction of seasonal crop mapping.

6.2 *Enhanced growth prediction*

The RNN component, especially the LSTM networks, has been crucial in accurately predicting crop growth stages. By analyzing temporal data, the model successfully forecasts critical growth phases, allowing for timely agricultural interventions such as irrigation, fertilization, and harvesting. Predictive accuracy for growth stages showed a substantial increase, with prediction errors reduced by over 30% compared to baseline models as shown in Figure 7.

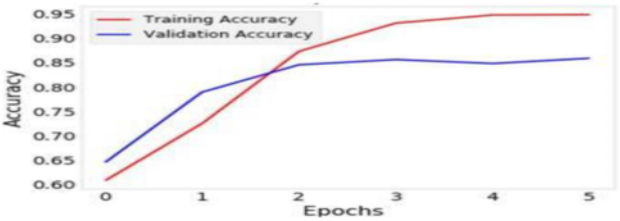

Figure 7. Training and validation accuracy of seasonal crop mapping.

6.3 *Operational efficiency*

By automating crop mapping, the model reduces time and labor from manual surveys, enabling frequent updates and real-time monitoring for agile agricultural practices.

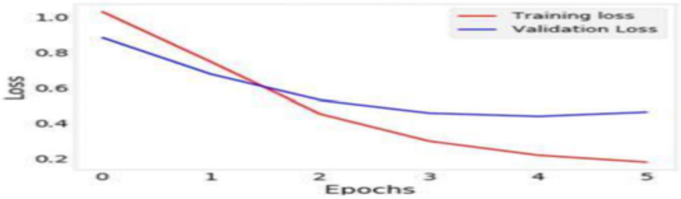

Figure 8. Training and validation loss of seasonal crop mapping.

7 CONCLUSION

Precision agriculture advances with deep learning (RNNs and CNNs), enhancing crop mapping accuracy and growth prediction. Integrated with GIS for real-time insights, it optimizes resources and supports sustainable farming practices, promising to meet future agricultural challenges effectively.

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Ensembling classical machine learning and deep learning approaches for morbidity identification from clinical notes

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ABSTRACT: In this study, we offer a unique technique for detecting co-morbidity in patient clinical data, employing Latent Dirichlet Allocation (LDA) for topic modelling. The LDA method is used to extract latent themes from the clinical notes. By using these selected themes as the foundation for feature representation, the data is represented in a way that is easier to understand and more concise. The possibility of LDA in identifying significant connections between subjects and health problems by using the topic-based characteristics for morbidity categorization. Our method aims to improve co-morbidity diagnosis via simplicity, interpretability, and efficacy. We want to show the effectiveness of the LDA-driven system in assisting with the precise and perceptive categorization of medical diseases from clinical data by means of a thorough study and comparison with current approaches.

Keywords: Machine Learning, Multimorbidity, Natural Language Processing, and Word embedding

1 INTRODUCTION

A combination of conventional machine learning with cutting-edge deep learning methods has shown promise within rapidly changing field of healthcare for improving the detection of morbidity from clinical notes. This synergistic approach leverages the intrinsic ability of deep learning models to identify complex and hidden characteristics within unstructured clinical narratives, and the benefits of standard machine learning algorithms, which excel in identifying explicit patterns from structured data. Our work intends to capture a more complete and nuanced knowledge of morbidity markers by combining these disparate methodologies, which will eventually lead to better patient outcomes and diagnostic accuracy. Our emphasis on using machine learning to identify morbidity from clinical notes is a calculated attempt to take use of computing power to extract complex patterns found in the patients structured and unstructured data records. Our goal is to increase morbidity detection accuracy and efficiency by using algorithms that learn from experience and use that knowledge to make better clinical decisions and provide better treatment for patients. The advent of information technology systems has led to an ongoing production, processing, and analysis of an increasing number of clinical records. Clinical report information encoding may be utilised to solve issues with people's social and economic standing by developing new healthcare services on a worldwide scale. Clinical reports, for instance, can be applied to the creation of content-based services that help individuals and medical professionals. They compare a board variety of data in numerical formats (e.g., lab results), pictorial formats (e.g., X-rays), medical descriptions (e.g., treatment histories), and transcript formats (e.g., motivational interviewing therapy sessions). Healthcare data comes in a variety of unstructured and diverse formats, making it difficult to analyse and interpret for humans. Artificial Intelligence technology is therefore being used more widely to analyse healthcare massive

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data [7]. We want to advance healthcare analytics and improve our knowledge of morbidity identification in clinical settings by exploring the depths of data to uncover hidden patterns that may defy current methods.

2 RELATED WORKS

Improved patient mortality risk prediction, as suggested by Hans-Christian Thorsen-Meye [1] *et al.*, might be useful in intensive care unit (ICU) decision-making. For ICU populations, a number of prognostic scores have been created, including the Simplified Acute Physiology Score (SAPS), the Chronic Health Evaluation and Acute Physiologic Assessment, and the Mortality Prediction Model. [1–4] However, poor accuracy makes patient-level usage difficult. [1,5,6] Additionally, since the majority of current ratings are derived based on information gathered the day of ICU admission, they are static.

Clinicians may turn to biased subjective judgment if they lack the necessary tools for patient-level prognostication. [7]. Furthermore, it is possible to overlook occurrences that significantly alter a patient's prognosis. Contemporary intensive care units continuously produce enormous volumes of data that provide important insights into the outcomes of their patients. Traditional statistical models are challenged by the data, which are frequently diverse and comprise inconsistently sampled, artifact-filled, and varying degrees of completeness structured and unstructured information.

Complex data may be extracted via machine learning, imprecise information and offer it to improve healthcare making decisions. Recent in silicon research has resulted in machine learning-based prediction models that outperform traditional methods using ICU data. [8–10] It is not surprising that a complicated model outperforms a simpler one; yet, superior performance comes at a cost: these models may be viewed as "black boxes," limiting their acceptability by clinicians and raising ethical and legal concerns. Our mortality prediction model is powered by a synthetic neural network featuring an LSTM architecture for long short-term memory, which links it to contemporary clinical practice by integrating accuracy data.

In this study, Chi-Shin Wu [2] *et al.* Have suggested Schizophrenia is a severe and long-term mental disorder.

Antipsychotic medication is used as a routine therapy to alleviate symptoms and prevent recurrence. [3]. However, research found that the initial antipsychotic drug only significantly improved the symptoms of 60% of people with first-episode schizophrenia, with 33% to 72% changing or quitting therapy within a year of starting it due to ineffectiveness or adverse effects. Poor long-term functional results and the likelihood of recurrence are both increased by inadequate therapy. Numerous observational studies and clinical trials have looked at the risk profiles and relative therapeutic efficacy of antipsychotic medicines.

While some current research has sought dependable prescriptive indicators of the effectiveness of antipsychotic therapy (predicting which antipsychotic drugs are most appropriate for specific individuals), others have sought dependable predictive indicators of antipsychotic treatment response (i.e., variables linked to treatment response independent of treatment kind) to support choices about psychoeducation and supplementary psychosocial treatment. Because prescriptive predictors are infrequently utilised in clinical settings, composite models are being used to develop individualised treatment regimens. ITR development has shown interesting results, however no workable ITR has yet been proposed.

In this research, DANILO DESS [5] *et al.* have proposed Clinical notes, which include written descriptions of a patient's health status, photographs, and clinical outcomes, are becoming more and more common in today's healthcare system. All of this data may be examined and used to provide innovative services that assist users and subject matter experts with their everyday healthcare activities. However, research into several technologies, like Deep Learning, and tools, like Word Embedding's, has just recently begun, and there are still many unanswered questions about their use in the healthcare industry. We suggest using

Word Embedding's and Deep Learning to detect sixteen different forms of morbidity from textual descriptions found in healthcare records in order to overcome these difficulties.

3 MODULES DESCRIPTION

3.1 *Data preprocessing*

The clinical record data must be cleaned and prepared by the pre-processing module before being subjected to further analysis. It might include things like stemming, stop word removal, tokenization, text cleaning, and managing irrelevant or missing data. Making ensuring the data is in a format that is appropriate for further processing stages is the aim.

3.2 *Bayesian classification approach*

In this module, a Bayesian classification approach to health diseases is used, with an emphasis on illnesses connected to the brain, cancer, diabetes, heart problems, and polycystic ovarian syndrome (PCOD). A statistical technique called Bayesian classification applies probability theory to data-driven predictions and judgments.

3.3 *Feature score*

The feature score module evaluates several characteristics that are taken from the clinical records in terms of their significance or applicability. Features might be words, phrases, or subjects that the LDA algorithm has determined. Finding the most instructive aspects that support the categorization process is made easier with the aid of this phase.

3.4 *Classification*

The essential component of the suggested system is the categorization module. Using preprocessed and feature-scored data, it categorizes clinical record ds according to certain medical diseases. In your instance, the categorization focuses on diseases of the brain, diabetes, cancer, heart problems, and PCOD. In this case, predictions based on the determined probability for each class are probably made using the Bayesian classification networks.

4 PROPOSED SYSTEM

The system under consideration presents a novel technique for identifying co-morbidity in patient clinical data. It employs a Bayesian classification methodology specifically designed for illnesses linked to the brain, diabetes, cancer, heart problems, and PCOD. The preprocessing module of the system is responsible for cleaning and preparing the data from the clinical records. It is succeeded by a feature scoring mechanism that evaluates the significance of the features that are extracted, including themes that are discovered using Latent Dirichlet Allocation (LDA).

Based on the collected data, the system then uses the Bayesian classification technique to classify clinical records into certain health categories. By integrating interpretable and condensed feature representations, this modular system seeks to improve co-morbidity detection by offering a simple yet efficient method for precise categorization. The effectiveness of the approach is thoroughly assessed and contrasted with current techniques, highlighting its potential contributions to accurate and perceptive categorization of health conditions from clinical data.

5 ALGORITHM IMPLEMENTATION

The technique starts by cleaning and preparing clinical data for analysis via preprocessing. After that, feature scoring is used to assess the importance of the extracted features, including any themes found via the use of Latent Dirichlet Allocation (LDA). Then, clinical data are classified using Bayesian classification into groups according to health conditions such brain disorders, diabetes, cancer, heart issues, and PCOD. Condensed and interpretable feature representations are included into the algorithm to improve co-morbidity identification efficiency and simplicity. It shows possible contributions to precise and insightful classification of health disorders from clinical data via a comprehensive evaluation and comparison with current methods.

Caveats

- LDA assumes that documents on the same topic share many similar terms.
- LDA is a bag of words model, focusing on individual tokens rather than their links within a phrase.

Math

- The most popular method for estimating the LDA model is the Gibsons sampling technique.
- The following represents the possibility that a word in a document is connected to subject j:

$$P(z_i = j|\mathbf{z}_{-i}, w_i, d_i, .) \propto \frac{C^{WT}_{w_i j} + \eta}{\sum_{w=1}^{W} C^{WT}_{wj} + W\eta} \frac{C^{DT}_{d_i j} + \alpha}{\sum_{t=1}^{T} C^{DT}_{d_i j} + T\alpha}$$

Where

- W stands for vocabulary length, or the total number of unique words.
- T denotes the quantity of topics.
- The matrix C_{dj}^{DT} represents the number of times subject z is related to word w in document d.
- The matrix C_{wj}^{WT} shows how many times word w is assigned to subject z.

One hyperparameter is α. A height value produces many more prominent issues, but a low alpha value prioritises having only a few dominating themes in each page.

5.1 *The LDA formula*

Applying the categorization criteria to minimise we calculated the Total Error of Classification (TEC), we aim to reduce the fraction of objects misclassified as much as feasible. TEC is the ‘long run’ performance rule applied to a random sampling of items. Thus, TEC should be studied because there’s a chance the rule under consideration may incorrectly categorize an item. The categorization rule places an object into the group with the highest conditional probability. This is known as the Bayes’ rule. This regulation also reduces the TEC. If there any group exists, The item is assigned to one of them using Bayes’ rule.

$$\mathrm{P(i|x) > P(j|x),\ \ for\ ¥\ j \neq I} \tag{1}$$

If we are given a sequence of measurements x, we want to determine the probability P(i|x) that an item belongs to a group i. It is quite hard to find the value of P(i|x). P(x|i) is what we can achieve. This is the likelihood, assuming that the item is from a group, of obtaining a particular set of measurements, x.

For example, after deciding if the soap is nice or bad, we may quantify it (weight, aroma, colour, etc.). We want to know if the soap is in a good or bad group based only on its measurement. Fortunately, there is a connection between the two conditional probabilities, known as Bayes' Theorem:

$$P(i/x) = P(x|i),\ \ P(i)/\Sigma\ \ P(x|j),\ \ P(j) \tag{2}$$

Previous odds the probability that the group is known in the absence of measurement is P (i). In actuality, we may alternatively assume that the prior probability varies depending on the number of samples in each category or is the same for all groups. However, as calculating P(x|i) needs a substantial quantity of data to ascertain the relative frequencies of each group for each measurement, applying the Bayes rule directly is not feasible. Assuming a distribution and doing a quantitative calculation of the probability is more practical.

6 RESULT ANALYSIS

This method analyses clinical data with a 75% accuracy rate by using natural language processing (NLP) techniques. To find themes in the data, latent Dirichlet allocation (LDA) is also used, which results in a 90% accuracy rate. While NLP analyses and comprehends textual data, LDA focuses on identifying hidden themes or subjects in the dataset. This suggests that while NLP may achieve a respectable degree of accuracy, using LDA to find themes improves the algorithm's performance considerably. This is probably because LDA can find pertinent patterns and relationships between the many health problems that are included in the clinical data as shown in Figure 1.

Table 1. Comparison table.

ALGORITHM	ACCURACY
NLP	75
LDA	90

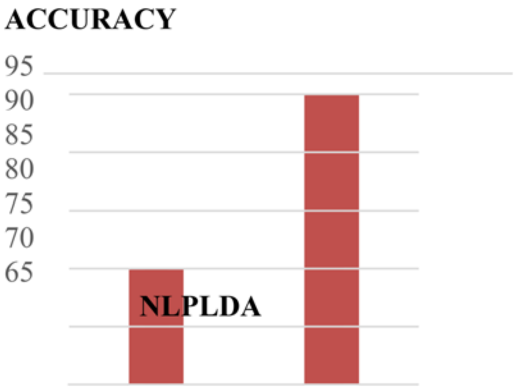

Figure 1. Comparison graph.

7 CONCLUSION AND FUTURE WORKS

To sum up, the co-morbidity detection system that has been suggested offers a fresh and efficient method for categorizing medical diseases in patient clinical data. The system seeks to improve and expedite co-morbidity detection by including a Bayesian classification approach specific to brain-related illnesses, diabetes, cancer, heart related disorders, and PCOD. The system offers a comprehensive but simple solution by using a strong pre-processing module for data preparation and Latent Dirichlet Allocation (LDA) for topic modelling. The system is practically useful in the healthcare area because it places a strong focus on interpretability, simplicity, and efficacy in feature representation and scoring. For future work, the co-morbidity recognition system could be extended and refined in several dimensions. Further exploration into advanced machine learning techniques and ensemble methods could enhance the classification accuracy and robustness of the system. Integration with additional data sources, such as genetic information or patient demographics, could provide a more holistic view for comprehensive co-morbidity analysis.

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Evaluating subjective answers using RNN and NLP

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ABSTRACT: Evaluating subjective, open-ended answers is very difficult to do in manually. Existing automated methods have limitations in truly understanding the actual meaning behind answers. To address this, this paper puts forward a new integrated approach using natural language processing and machine learning methodologies to evaluate score descriptive answers automatically. We assembled a dataset for this study that included more than a thousand subjective questions along with sample answers, student responses, and crucial keywords. The dataset was also annotated to facilitate training and assessments. The proposed approach Utilizes semantic techniques like word2vec to represent words in a way that Maintains meaning, and semantic measurement using word mover's distance similarity between answers, unlike conventional methods. Without using any machine learning model, the proposed techniques alone achieve remarkable 85% accuracy in automatically scoring answers, which further improves to 86.3% accuracy when adding a machine learning model. In this paper, we propose improved way which analyse written answers using advanced computer methods. The proposed techniques and annotated dataset have strong potential for real-world application in education and examinations that involve open-ended subjective questions.

Keywords: Recurrent Neural Network, word2vec, Natural Language Processing, Subjective answer evaluation

1 INTRODUCTION

In education, it is necessary to ask subjective questions to check the understanding of the student, the critical thinking the analytical skills. They gave students an opportunity to articulate their understandings and understandings of a theme, providing educators perspectives about their understanding and language conventions. The paper presents a way for the automation of subjective answers by ML classifiers and NLP. The process includes both semantic similarity, where answers are compared to a reference text, and keyword extraction similar measures like word mover's distance. For example, in responding to a question about Paris being the capital of France, the system would analyze the response and grade it against a standard it compares to and sees if all the applicable terms were included. Text representation techniques like TF-IDF and word embeddigns, methods to check similar nifty words like word mover's distance and cosine similarity, and machine learning algorithms like rnn. And lastly, we touch on the evaluation metrics used to measure our models' performance in comparison to the literature.

2 LITERATURE SURVEY

Y. Dong and J. Wang [1] suggested an alternative method for calculating the semantic similarity of texts. These methods include graph-structure-based, string-based, corpus-based,

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and semantic text matching techniques. A. P. Johnson and V. Holmes [3], and W. Qurashi proposed a system that uses natural language processing, or NLP, techniques to automatically identify similarities between documents. The purpose of this system is to compare and understand word and sentence meanings (lexical and semantic analysis) in order to determine the degree of similarity between two documents. L. A. Cutrone and M. Chang [2] presented a system is a computer program designed to automatically grade open-ended questions in online learning platforms. It uses special techniques to understand and evaluate what students write, making sure it grasps the meaning of their words. V. Bahel and A. Thomas [4] proposed a computer-based method for grading long, written answers in exams. This method uses Natural Language Processing (NLP) and Data Mining techniques to read and grade student answers P. Patil et al. [5] designed a system for grading essay responses using machine learning and natural language processing. It evaluates answers based on their length, keyword usage, context, grammar, and relevance to the question. M. Montes-y-Gómez *et al.* [6] given an advanced system for finding documents based on a user's search query, using a two-step process. A. Winchcombe, S. Kajornkasirat, and J. Muangprathub proposed a system [7] for detecting plagiarism that matches allegedly plagiarized documents with possible sources by applying Formal Concept Analysis (FCA). A Decision Support System (DSS) for crime incident documents was proposed by R. S. Wagh and D. Anand [8]. Its goal is to recommend the most pertinent section of the Indian Penal Code (IPC) based on a comparison of user input with IPC section documents using a vector space model. X. Hu and H. Xia [9] presented a system talks about a computer system designed to grade written answers in exams automatically. It works by comparing the answers written by students to those provided by the instructor. R. Sato *et al.* [10] used the system that looks again at Word Mover's Distance (WMD) and how it performs in classifying documents. The authors discuss the importance of making sure all the data is in a similar format to get accurate results. Mittal and M. S. Devi [11] proposed a Latent Semantic Analysis (LSA) is to evaluate technical answers in education. It clusters text based onsimilarity, allowing comparison between student and model answers by converting them into vectors and calculating cosine similarity. Schoheld, M. Magnusson, and D. M. Mimno [12] proposes a system of reconsideration of stopword removal in topic modelling, suggesting that traditional methods may not offer significant benefits. S. Aryal *et al.* [13] proposed a system in the document is a new inter-document similarity measure called Sp. According to a novel approach described by S. Afzal *et al.* [14], the system URLdeepDetect uses a deep learning approach by leveraging semantic vector models to detect malicious URLs.

3 PROPOSED METHODOLOGY

The proposed system will collect and label data, clean it up, measure similarities, train models, make predictions, and provide final results. Teachers first gather and annotate subjective question answers with scores. Preprocessing techniques used on the data include tokenization, stemming, lemmatization, stop word removal, case conversion, and meaning analysis. Two similarity measurement techniques are used – Word Mover's Distance (WMD) and Cosine Similarity. Different thresholds are set for high and low similarity. WMD keeps semantic meaning intact better than cosine similarity. The initial result predicting module calculates scores based on similarity and presence of keywords. These scores are used to train a RNN machine learning model to categorize scores. The machine learning model provides suggestions on the scores predicted by the result module. The main advantage is that the machine learning model acts as a confidence booster and can eventually work independently after enough training data.

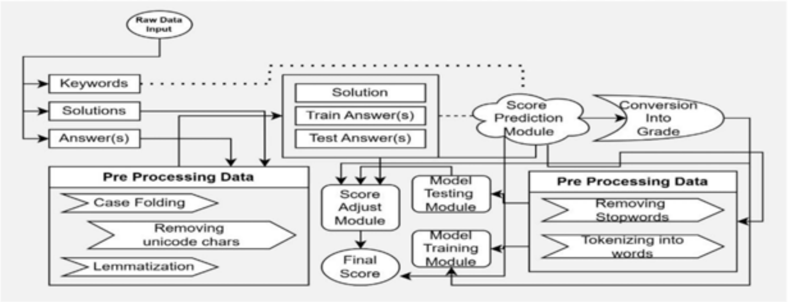

Figure 1. Proposed system.

3.1 *Comparing similarity module*

This step involves using two functions called WDM and Cosine Similarity to see how similar two sentences or word groups are. WDM tells us how different two things are, while Cosine Similarity tells us how similar they are. We use both of these functions separately and compare the results in the end. We have different levels of similarity or difference that we look for, which are listed in Table 3.

3.2 *Result predicting module*

The Result Predicting Module is the main part of this project. It works based on Algorithm 1, which is shown in Figure 1. We calculate the overall score using either Word Mover's Distance (WMD) or Cosine Similarity, and we look at the most matched pairs of sentences in the solution and the answer. We can compare this result to a real score or use it to train a machine learning mode.

3.3 *Understanding thresholds*

In this paper, we've figured out the best settings for certain limits called thresholds. For example, we have two thresholds called WDM_LOWER and WDM_UPPER, which show how different two sentences are. A higher number means they're more similar. We found that a WDM_LOWER threshold of 0.7 means the sentences are very similar, while a WDM_UPPER threshold of 1.6 means they're less similar. If the number is over 1.6, it's considered too different to compare Similarly, we have thresholds for cosine similarity called COS_LOWER and COS_UPPER, which show how similar two sentences are. Unlike WDM, cosine similarity doesn't consider the context of the sentences when measuring similarity. That's why we use both of these methods to measure similarity or differences (Table 1).

Table 1. Thresholds similarity.

Threshold Notation	Threshold Value	Threshold Description
WDM_LOWER	0.7	By using WDM the dissimilarity between two sentences is < = 0.7 shows sentences are semantically very similar.
WDM_UPPER	1.6	By using WDM the dissimilarity between two sentences is < = 1.6 shows sentences are semantically a little bit similar.
COS_LOWER	0.2	By using Cosine Similarity the similarity between two sentences is > = 0.2 shows sentences are semantically a little bit similar.
COS_UPPER	0.7	By using Cosine Similarity the similarity between two sentences is > = 0.7 shows sentences are semantically very similar.

3.4 *Machine learning module*

Machine learning models that have been trained using data from the Result Prediction Module are included in the Machine Learning Model Module. Here's how it functions:

- Input the given data obtained from the Result Prediction Module.
- Count Vectorizer can be used to represent unrelated words and convert them into Bag of Words or TF-IDF forms, which will help you prepare the key and answer.
- Sort the overall score that was acquired from the module for result prediction into distinct groups. To represent the various score ranges, the paper employs four categories: 1, 2, 3, and 4.
- Choose a ML model which is good for classifying multiple categories.
- Evaluate the preprocessed response using the machine learning model to forecast its category. Verify this category against the outcome from the Result Prediction Module to ensure the prediction's reliability.

Initially, the model is not very accurate, so it's important to train it with some data before using it. The model boosts confidence in the Result Prediction Module, especially once its trained basis on data. It also predict grades or categories for answers on its own, without needing additional modules like word2vec or the Result Prediction Module. This makes it a standalone evaluator for specific questions. Additionally, the model helps handle case where the Result Prediction Module struggles due to differences in meaning, thanks to its training data. The preprocessed answer, along with its label, is used to update the model with new information. The predicted category is then forward the solution, response, and total score to the Final Score Prediction Module.

3.5 *Module for predicting final score*

The machine learning module's output is fed into the final score prediction module, which then determines whether the predicted class and overall score match. The score is decided if they coincide. If not, we deduct or add half of the value range from the score, depending on whether the predicted score is higher or lower than the expected score. If the predicted score matches the actual score, we accept it as correct. If there's a discrepancy, we either assume the machine learning model needs more training and stick with the original score, or if the model is well-trained, we accept the adjusted score as final. This process accounts for some inaccuracies from the marks obtained from Score Prediction and the Machine Learning Module.

4 EXPERIMENTATION AND RESULT

Using a Python notebook with 12 GB of RAM and 100 GB of storage on Google Colab, we ran an experiment. No GPU was used in this experiment. We made use of a 200-dimensional, roughly 100 billion word vocabulary pre-trained word2vec model from Google. Our data was split up into 20% for testing and 80% for training. Initially, we trained a machine learning model and computed initial scores using the training data. Next, we used the testing data to test the model, and with each test, we updated the model .To obtain our results, we employed an RNN model in conjunction with word mover's distance and cosine similarity. Both methods yielded a result on Google Table 2 in less than a minute, with and without the model.

Table 2. Score prediction using word mover's distance before and after suggesting model.

Human Score	WDM Score	Error in (%)	Human Score	Error without model	Error with model
24	34	11	48	21	8.5
73	52	23	48	18	3.5
81	53	29	65	15	26.5
25	12	11	65	17	25.5
15	86	14	60	8	2.5
8	1	10	60	26	13.5
0	0	6	28	24	10.5
47	0	0	0	0	15.5
65	36	15	79	45	28.5
55	65	8	30	28	11.5

A comparison of the first ten responses used for training is shown in Table 2. The score prediction module achieves an 88% success rate, which is impressive given its accuracy. This level of accuracy is important because the word2vec model is good at capturing the semantic core of answers and encouraging a notable level of coherence between them. Examining Table 2, it is clear that the errors are displayed with and without the model. Using model recommendations for this small dataset results in an average error reduction of 15.6% to 13.94%, according to the comparison. As a result, the model's increased confidence helps to improve the evaluations' accuracy.

Table 3. Utilizing cosine similarity for score prediction, along with model suggestions.

Human Score	Cosine Similarity score	Error in (%)	Human Score	Error without model	Error with model
21	35	15	45	11	0.5
75	75	2	45	11	0.5
81	75	9	63	17	25.5
22	35	15	63	17	25.5
75	96	28	56	9	4.5
15	19	8	56	26	11.5
8	0	6	28	20	6.5
0	20	10	0	16	24.5
49	45	11	79	29	12.5
61	81	16	29	1	13.5

Table 3 shows differences in scores produced by the cosine similarity method in the absence of model intervention. The reported accuracy of 87% is mainly ascribed to the algorithm's usage of sentence mapping and keywords. The changes in errors following the application of the machine learning model correction are shown in Table 3. The results indicate that when cosine similarity and classification models are integrated, the accuracy of the model is reduced by 1.54%. For this small dataset, cosine similarity achieves an 86% accuracy rate when combined with a machine learning model.

5 CONCLUSION

Assessing subjective answers such as essays can be a challenging and mistake-prone process when performed manually. This paper explored using natural language processing and machine learning techniques to automate the evaluation process. Their proposed approach involves a two-step method. First, they use semantic similarity measures like Word Mover's

Distance to compare student answers to sample solutions, also factoring in keyword matching. This gives fairly accurate scores on its own. Then, they feed these initial scores into a machine learning model like RNN to train it to predict scores. The model helps refine the initial scores and boosts the accuracy further. The key findings were that semantic similarity measures like Word Mover's Distance perform better in simpler methods like cosine similarity, as they account for meaning and not just word overlap. Also, combining the semantic similarity scores with a machine learning model provides a significant boost in accuracy over using just one method.

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Food recognition system using deep learning

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ABSTRACT: The Food Recognition System (FRS) is an advanced technological innovation that combines computer vision and artificial intelligence. In a world characterized by vast culinary diversity, Food Recognition System serves as a powerful tool for automating the identification and categorization of various food items through image analysis. We propose the utilization of VGG30, a highly accurate deep learning model, for food recognition. VGG30 is a convolutional neural network (CNN) specifically designed for image grouping. By training it on a dataset of food images, it can successfully identify a wide range of food items. To employ VGG30 for food recognition, it is necessary to first gather a dataset of food images, with each image labeled to indicate the type of food it represents. Once the dataset has been preprocessed, the VGG30 model can be trained using it. its deep architecture allows it to capture intricate features of different food items, ensuring robust performance even in challenging conditions such as varying lighting, angles, and backgrounds. VGG30 is a reliable choice for accurate food recognition across various domains. Finally, its adaptability allows for fine-tuning to specific tasks or preferences, making it an ideal candidate for implementing the Food Recognition System. After training, an independent test set can be used to assess the model's performance before it is put to use in real-world scenarios.

Keywords: Continual Learning, Long-Tailed Distribution, Food Recognition, CNN-based features

1 INTRODUCTION

The development of contemporary deep learning technology has made it possible to automatically analyze the nutrition content of food, including image-based dietary evaluation [1]. This information may be used to monitor and guide actions aimed at enhancing dietary intake and preventing chronic diseases like diabetes. In numerous applications for diet based on appearance evaluation, such as meal portion sizes and food classification estimate, deep learning based approaches have produced outstanding results [2]. Food picture categorization facilitates the analysis of nutrient intake from collected food photographs and it is a fundamental and important stage in the assessment of diets using images. The inherent anomalies in nutrition databases, which are in charge of connecting each "food item" to its associated data, are the cause of this restriction [3]. In order to achieve this, we use CutMix, an image-mixing data augmentation technique [5]. As a result, dietary evaluation plays a critical role in healthcare-related applications [6] because of recent developments in novel computation techniques and novel sensor technologies. Since transferring rich settings from majority to minority samples is our main concept. Within computer vision and artificial intelligence, food recognition is an exciting and quickly developing topic. After extracting features from an image collection using Gabor BOF, classification is performed using the Euclidean distance. Phetphoung *et al.* [12] extracted characteristics by using colour histograms in RGB, HSV colour spaces, and form attributes. Lastly, the sushi dataset is classified with a 93.7% accuracy rate using the k closest neighbour method. Using the nearest neighbour classifier, Kong *et al.* [13] built dietcam and applied it to sift characteristic extractor on

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five food types, achieving 92% accuracy. how to correct the model when new food classes gradually emerge over time, and how to deal with the serious class imbalance problem given that real-world food photos typically follow a long-tailed distribution, as seen in [14]. Due to the widespread use of social media and smartphones, there is an increased need for food-related content sharing, which makes automatic food detection both a technological difficulty and a practical requirement. The concept of continual learning also referred to as lifelong learning or incremental learning is a paradigm within the field of artificial intelligence and machine learning. Its primary objective is to address the challenge of adapting models to evolving data distributions over time. Image-based dietary evaluation is the practice of using visual data to infer an individual's food intake and energy and nutrient consumption. Classifying food is the first and most important step[8]. This dynamic framework is particularly crucial in real-world applications where data is non-stationary, as it allows models to remain relevant and effective in the face of changing circumstances [9]. A long-tailed distribution is a statistical phenomenon that is characterized by a significant concentration of occurrences in the tail end of a distribution. This is where rare events or extreme values are more prevalent than in a typical distribution [10]. In contrast to a normal or bell-shaped distribution, where most data points cluster around the mean and tail off gradually, a long-tailed distribution demonstrates a prolonged and often heavy tail, indicating a higher frequency of infrequent events. This distribution pattern is pervasive in various real-world scenarios, ranging from income distribution and web traffic to the occurrence of rare diseases. Assessing your diet is crucial to keeping up a healthy lifestyle. Because gadgets that take pictures, like smartphones, are becoming more common, research on automated nutritional evaluation using images is expanding [11].

2 LITERATURE REVIEW

Jianping He [1] *et al.* Have advanced the suggestion that profound learning-based techniques have exhibited wonderful result to several applications of picture-based diet evaluation, such as food segment size assessment and food categorization. Be that as it may, the ongoing strategies exclusively focus on each undertaking in turn, delivering it burdensome to apply in functional situations where various errands should be handled at the same time. The authors used multi-task learning, which trains the classification and regression tasks concurrently with soft parameter sharing based on L2-norm, to address this issue. To increase food portion size estimation accuracy even more, the authors have also suggested combining normalization with cross-domain feature adaptation. Xinyue [2] Dish and partners have suggested that food picture characterization is an essential and primary phase in the picture-based dietary assessment process, as it works with the examination of supplement consumption from caught food pictures This restriction is caused by the inherent variations nutrition databases, which are in charge of connecting each "food item" to the relevant data for it. Subsequently, the point of this review is to order food things in arrangement with the nourishment data set. To accomplish this, the creators present the VFN-supplement dataset, which clarifies every food picture in VFN with a food thing that incorporates dietary structure data. The issue of class imbalanced information in this framework, as recognized by Seulki Park [4] *et al.*, is that the classifier's speculation execution disintegrates because of the absence of information from minority classes. In this exploration paper, we present an original way to deal with address this issue by proposing a minority over-examining strategy that expands different minority tests utilizing the rich setting given by larger part classes as foundation pictures. Jiangpeng He [5] *et al.* have proposed a framework in which food grouping fills in as the underlying step for picture based dietary evaluation, expecting to anticipate the kinds of food sources in each info picture. Moreover, none of the current long-followed arrangement strategies explicitly center around food information, which presents extra difficulties because of the likenesses between various food classes and the variety inside every food class. To address these difficulties, this review presents Two fresh benchmark datasets for meticulously tracked meal orders: Food101-LT and VFN-LT. https://drive.google.com/drive/folders/1rs-6AE4tuZlDM13bQh6fKtdheqAt8JmK

3 EXISTING SYSTEM

Food recognition using deep learning has made significant advancements in accurately predicting food types based on images of eating occasions. However, there are two significant barriers that impede its implementation in reality. Firstly, as new food types emerge over time, a trained model must continuously learn these new classes without erasing the previously acquired knowledge of existing food types. This is crucial to prevent catastrophic forgetting. Secondly the dissemination of real-world food photos is typically imbalanced, with a select few widely consumed food varieties are consumed more often than others. Consequently, a food recognition algorithm needs to be able to adapt to unbalanced input, specifically improving its ability to generalize to rare food classes. In this study, our focus is on addressing both of these challenges through long-tailed continual learning. of individuals taking insulin.

4 PROPOSED SYSTEM

The introduction of Food Recognition Systems (FRS) is an important advancement in the field of technological innovation, offering a sophisticated solution to the complex and widespread challenges associated with food identification. In an era where visual content dominates our digital landscape, FRS utilizes the capabilities of computer vision and artificial intelligence to decipher and categorize a wide range of culinary offerings. The proposed system for food recognition, employing VGG30, is a convolutional neural network (CNN) that undergoes training on a dataset of food images. The CNN is capable of acquiring knowledge about the distinctive features of various foods and utilizing this knowledge to identify foods in new images. The system operates by initially preprocessing the input image, which may involve altering the image's dimensions, adjusting the pixel values, and transforming it into a format that works with VGG30. Once the image has been preprocessed, it is fed into the VGG30 model. The model then extracts features from the image and employs these features to make predictions regarding the kind of meal that's shown in the picture. The model's result is a forecast for the kind of food that is shown in Figure 1.

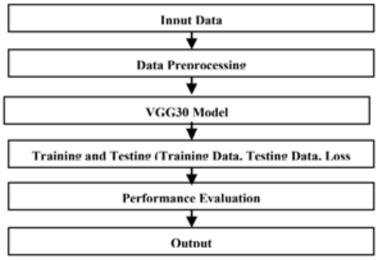

Figure 1. Flow diagram of food recognition.

4.1 *Load input data*

In the preliminary stage of constructing a food recognition system utilizing VGG30, the input data is retrieved. This dataset encompasses a multitude of images depicting diverse food items, which will be employed for the purpose of training and evaluation. Each image within the dataset is linked to a distinct food category, thereby establishing the foundation for the classification endeavor. The process of loading the input data entails arranging and readying the dataset to be inputted into the neural network during the subsequent training phase.

4.2 *Data preprocessing*

After the loading of the data, it undergoes preprocessing to guarantee its suitability for training by following a series of steps. These steps include resizing images to a consistent size, standardizing the range of pixel values, and maybe adding additional information to the data using methods like flipping or rotation. Data preprocessing plays a vital role in improving the model's capacity to extrapolate patterns from the training data to novel, unseen examples.

4.3 *Feature selection*

In this module, the utilization of VGG30 entails the concept of "feature selection" which pertains to the extraction of significant features from images. Nevertheless, deep learning models like VGG generally possess the ability to autonomously acquire pertinent features during the training process, thereby rendering explicit feature selection unnecessary in a manner similar to traditional machine learning. The convolutional layers of VGG are specifically engineered to automatically identify hierarchical features within images.

4.4 *Training and testing*

The VGG30 model is trained using a subset of the data known as the training set, after preprocessing the data. During the training phase, the model gains the ability to identify patterns and characteristics within the images corresponding to various food categories. To assess the capacity of the model to generalize to novel and unseen examples, a distinct portion of the dataset, referred to as the testing set, is employed. This testing set remains unseen by the model during the training process. The training procedure entails modifying the model's weights in accordance with the error or loss computed during each iteration.

4.5 *Performance evaluation*

Upon completion of the training and testing of the food recognition system utilizing VGG30, its efficacy is assessed through the utilization of various metrics, such as F1 score, recall, accuracy, and precision. These measurements offer insightful information on how well the system categorizes food items. High degrees of accuracy shows how adept the algorithm is at accurately classifying the majority of examples, while precision and recall offer information regarding the system's capacity to make accurate positive predictions and capture all positive instances, respectively.

5 ALGORITHM DETAILS

The Food Recognition System (FRS) presented in this abstract is a cutting-edge technical development that combines computer vision and artificial intelligence to change the way people interact with and understand food. The suggestion supports the use of VGG30, a very accurate deep learning model, for food recognition tasks. VGG30 is a convolutional neural network (CNN) designed specifically for image categorization.

First, a dataset of food images is gathered, ensuring diversity across various food items, with each image labeled according to its corresponding food category. To make model training easier, the dataset is then pre-processed by normalizing pixel values and scaling every image to a consistent size. The dataset is then divided into training and testing sets in order to evaluate the model's performance. The VGG30 model receives training from the dataset by feeding training images into the model and adjusting its parameters using backpropagation, iterating until convergence or a predefined number of epochs is reached. Finally, the testing dataset is used to measure the model's performance and determine measures like precision, recall, and F1-score, which provide light on how well the model classifies food photos.

6 RESULT ANALYSIS

After training the Food Recognition System (FRS) with the VGG30 model on a dataset of food photos and assessing its performance on a separate test set, the findings show that it is quite accurate at recognizing different food items. The assessment criteria, which include accuracy, recall, and F1-score, show that the FRS is competent in properly categorizing food products via image analysis. The use of the FRS in practical applications enables users to easily recognize various types of food, speeding food identification operations and improving user engagement with food-related technology.One of the most widely used metrics for assessing classification performance is accuracy, which is calculated as the proportion of all samples to correctly segmented samples as shown in Figure 2.

$$Accuracy = TP/(TP + FN)$$

The percentage of positive class forecasts that really fall into the positive class is known as precision. It is calculated using the following approach.

$$Precision = TP/(TP + FP)$$

The ratio of in the data, true positives to total positives is known as recall. Sensitivity and recall are synonymous.

$$Recall = TP/(TP + FN)$$

Specificity in data is defined as the ratio of true negatives to total negatives. Specificity is the program's precise classification for all those who are truly well.

$$Specificity = TN/(TN + FP)$$

Table 1. Comparison table.

Algorithm	Precision	Recall	F score	Accuracy
CNN-VGG 30	0.73	0.7	0.74	0.71
VFN-INSULIN	0.8	0.8	0.84	0.8

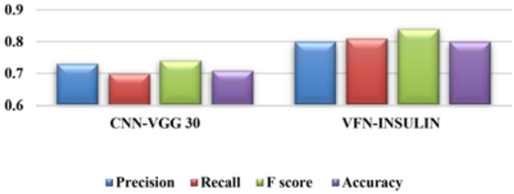

Figure 2. Comparison graph.

7 CONCLUSION AND FUTURE WORK

In Conclusion, constructing a food recognition system utilizing VGG30 poses a formidable challenge; however, it is indeed feasible to attain a commendable level of accuracy across diverse food recognition tasks by adhering to the aforementioned steps. The initial step entails amassing an extensive and heterogeneous dataset comprising a wide array of food images encompassing fruits, vegetables, meats, and prepared meals. Subsequently, the images necessitate preprocessing, which may encompass resizing, normalizing pixel values, and converting them into a format compatible with VGG30.In Future, Enhance the precision and resilience of the system by employing a broader and more varied dataset of food images, utilizing more advanced feature extraction methodologies, and implementing more potent machine learning models. Augment the efficiency and scalability of the system by utilizing lightweight models, optimizing the code, and employing distributed computing techniques. Foster a more user-friendly and accessible system by developing user-friendly interfaces and integrating the system with existing applications.

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Handshake between humans and artificial intelligence: A review

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ABSTRACT: The paper takes a close look at how human and AI interacts in many different ways. It talks about how important this interaction is. It discusses how Artificial Intelligence can bridge the generation gap by helping younger individuals to connect with their heritage and origins. This paper further navigates both the challenges and opportunities. It identifies the challenges such as interpretability, while points out transformative potential of AI in shaping the job scenario in healthcare and education, etc. It explores concerns regarding job displacement and need to ensure equitable job sharing era of AI. Finally, the review emphasizes its multidisciplinary nature.

Keywords: Artificial intelligence, Human-AI interaction, Cultural Heritage, Health Care, Environment

1 INTRODUCTION

The interaction &communication between humans and AI has taken important position and this relationship has presented huge challenges and opportunities ranging from seamless integration of AI into our daily lives to the way in which we interact with AI which has expanded beyond tradition interfaces such as Chabot, voice Assistant and other areas like medical diagnoses, autonomous car, vehicles, etc. The Handshake between human and AI workflow competence by leveraging its capabilities for task such as data analysis, decision making automation, data processing these things reduces manual efforts, repetitive task and allow human to concentrate or and enhance the productivity. [1,2] The artificial intelligence has inspire and elevated various sector from finance to education, healthcare and entertainment and across decades. These features are very beneficial for human. These increases efficiency, productivity and leads to cost savings and enhance the quality of life. However Artificial Intelligence cannot make decision of its own, so here the question comes that how AI and human interact over and over again. Human and AI cooperate consistently where AI can process, analyze vast amount of data quick and handle repetitive task efficiently on the additional hand human has the power of creativity, emotions, cleverness, understanding and make moral judgment. If AI and human collaboration take place so this collaboration will lead to improved efficiency, advance decision making this corporation will also boost the young generation's potentials by continuous development and growth.

1.1 *Importance of interaction and communication between humans and AI*

Interaction & communication between human and AI refers to exchange of information, ideas, actions by taking instruction from client to achieve specific goal working together to achieve general goal will lead to enhancing productivity, advancement in technology

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through innovation, research and development. The handshake and collaboration can extend to preservation and development of cultural skills AI technology can assist in digitalization and restoration of tradition art, language and pass this traditional heritage to upcoming generation so that they can learn about tradition in modern way, AI make history interesting and inspire young individuals to explore their roots while still enjoy new things around us. [3,7] Furthermore, this collaboration between human and AI is an approach progress. Whether it's in manufacturing, data science or diverse industries, the partnership between these two forces in remarkable results in manufacturing, smart assistant like chat bots are learning from workers, enhancing efficiency through information sharing. [4,5] In data science the automation of task by AI is promising yet experts emphasize the importance of symbiotic relationship where AI explains its decisions, trust and better outcomes. [6,17]

1.2 *Challenges and opportunities*

It has inspired and elevated and revolutionized way to interact with technology however there are numerous challenges, opportunities which is faced by AI. Furthermore, we come across a range of essential challenges. Many of the AI models, especially deep learning, neural network are complex "Black boxes" that means it's difficult to understand how the system is making the decisions. However, the system is able to analyze huge amount of data and learn but it is not clear that how it is making decision and this can be challenging because it is not easy to trust the system. The complexity in understanding how AI works, particularly in healthcare, makes it hard for people to believe and use it. This, can further make mistakes and lowers the quality of result but if we make it easier to understand it can help to doctor and patient. [8,9] AI have become widespread across various sectors and its misuse by malicious actors can leads to damaging activities. There are loopholes in AI model that can be broken and can lead to the attack such as United AI outcomes algorithm trading membership misinformation. Weapon system addressing and Hacking have become a critical challenges in the area of AI. [10] We need to sure that the AI system are built with the focus on users, which means creating a technology that people can trust and being open about how it work. This help in maintain transparency, so everyone understand how their data is used and kept safe. [11] AI's adoption for societal challenges requires robust security due to increasing vulnerability of AI model to advance hacking technique so cyber security is vital for safeguarding AI [12].

2 LITERATURE REVIEW

AI has numerous opportunities including ability to perform recurring task, analyze huge amount of data quickly AI also help us to better understand complex system and develop new technologies. In today's era AI is used to identify very high risk disease such as cancer, heart disease and Alzheimer by exploring deep learning algorithm and network which manage and monitor health information [13]. AI is making a big difference in health care. Hospitals are using AI to improve patient care and how things are run. Although AI has benefits, there are some challenges also but as AI keep getting better it gives us chance to make health care even better too. To make the best use of AI we need to plan carefully and use it in very elegant way. [14,15] AI is used in education to provide better learning experience for students, many of the students all over the world are using AI application for study and research.AI is changing multimedia education platforms by making interaction between student and AI powered system more lively an integrated AI frame work incorporate visual recognition and intellectual behavior, considerably enhancing teaching methods across world. [16] Optimize, renewable energy resource, protect wildlife through monitoring also help farming use better resources and watches the environment with satellite data, optimize waste , water management and suggest way to reduce carbon footprints. AI has data analysis automation capabilities which will create numerous smart plans that make future greener and better. [17] By recognizing AI's multidisciplinary nature and its applicability across different domain, we can affirm that AI has the potential to elevate our society, offering a multitude of opportunities across various fronts. [18] Similar to how machines transform tasks during the industrial revolution, it has power to change task that are challenging for humans. AI is used in various fields like industries, science and health care, creating new possibilities and challenges. AI technologies like machine learning and automation drive innovation and alter decision making. The impact of AI is felt in areas like finance healthcare, manufacturing. AI have an effect on industries and society, shaping their progress. This highlights the importance of understanding AI's Impact and its reach across field, contribute to diverse nature which shows the multidisciplinary nature of AI.

Sowa, Konrad *et al.* (2020) [1] research paper highlights importance of focusing on collaborative approaches between human and AI to enhance the future utilization of artificial intelligence. Xu, Bojue, *et al.* (2020) [2] The case study highlights successful human Ai collaboration modes like complimentary, modularity for better operational decision making, improve better outcome through balance collaboration. Pisoni, Galena, *et al.* (2021) [3] This research demonstrates crucial role of collaboration in preserving cultural heritage, guide younger generation, motivating them to explore their root and heritage.

Wang, Dakuo, *et al.* (2020) [4] This research paper shows that combining AI with human work require careful collaboration, exploring its feasibility, benefits.

Mantravadi, Soujanya, *et al.* (2020). [5] It mainly focusses industry, manufacturing, introduce a predictive chat bots as technical assistant for extracting information. Wang, Dakuo, *et al.* (2019): [6] this paper indicate AI rapid growth transforming various aspect of life including data science where auto AI assist by handling task, promoting collaboration between human and AI. Vössing, Michael, *et al.* (2022): [7] According to this research Making human AI collaboration better AI explain its actions, which increase trust and improve their work together and understanding transparency between AI and human.

Cai, Carrie J., *et al.* [8] Enhancing human AI interaction by highlighting what medical expert seeks when using AI for diagnosis, also highlights the productive partnership between experts and technology. Ennab, Mohammad, [9] and Hamid Mcheick. This paper underscoresthe lack of interpretability in healthcare AI makes it less reliable. Making AI clearer and more human like can improve healthcare, AI has potential to be better and trustworthy.

Blauth, Taís Fernanda, *et al.* (2022) [10] Zwitter The research paper emphasizes the importance of proactive measure, regulation and collaborations to prevent AI based crime and misuse.

Cheatham, Benjamin, *et al.* [11] "Confronting the risks of artificial intelligence." It indicates that AI offers substantial potential, concerns about its ethical, safety and societal implications need careful consideration and proactive management. Oseni, Ayodeji, *et al.* (2021) [12] It indicate that AI adoption solves challenges but requires robust security against hacking. Urgent resilient models and cyber security are vital for data privacy. Racine, Eric, *et al.* (2019) [13] The need for association between medical professionals and AI developers is discudded. Lee, DonHee, *et al.* (2021) [14] AI transforms healthcare by enhancing patient care and operations in hospitals offering benefits and challenges, create opportunities for improved healthcare with careful planning and smart use. Aung, Yuri YM, *et al.* [15] AI transforms healthcare, improving work flow and patient care. Governance is essential for maximizing benefits, similar to physical practice. (2021). Chen, Zhongshan, *et al.* (2021). [16] AI transformative role in multimedia education, through interactive communication and integrated frame works, enhancing higher education and improve student success.

Pedro, Francesc, *et al.* [17] It highlights the AI promising opportunities to enhance education and promote sustainable development Wilson, H. James, *et al.* [18] "The jobs that artificial intelligence will create." AI will create new opportunities and jobs that require human skills, such as, empathy, & creativity, also emphasize importance of developing these skills for innovations."

This research highlights the importance of understanding AI's Impact and its reach across field, contribute to diverse nature which shows the multidisciplinary nature of AI. It underscores the significance of explain ability of AI for health care also explore multidisciplinary implication, highlight its ethical importance.

3 DISCUSSIONS

Exploring the symbiotic relationship between humans and AI, "Handshake between Humans and Artificial Intelligence" delves into the evolving dynamics of collaboration and integration. The review scrutinizes as discussed in Table 1 how AI augments human capabilities, fostering efficiency, innovation, and problem-solving across various domains. Ethical considerations surrounding AI's integration into society, including issues of bias, privacy, and job displacement, are critically examined.

Table 1. Analysis of different themes.

S.No.	Main theme	Analysis
1	Cobots: Human–AI collaboration in decision-making profession.	It highlights importance of focusing on collaborative approaches between human and Ai to optimize upcoming application of AI in the work place.
2	Augmented Intelligence	Finding importance of human AI collaboration and decision making process for better outcome.
3	Human-centered-for designing easy to get to cultural heritage	The need for collaboration among experts in AI for cultural preservation.
4	Partnership	Combining AI with human work need careful collaboration, exploring it possibility, benefits and challenges, this can enhance productivity and innovation.
5	User-friendly MES interfaces	Focus on human AI communication in industry and manufacturing, introduces a predictive Chatbots as technical assistant for extracting information.
6	Teamwork scientist's perception	AI rapid growth transforming a variety of aspect of life including data science where auto AI assist by treatment tasks ,prompting collaboration between human &AI
7	Designing clearness for effective human-AI partnership.	Making human AI collaboration better AI make clear its actions, which increase trust and improve their work together and understanding clearness between AI and human.
8	Revealing joint decision-making.	Enhancing human AI interaction by highlighting what medical expert seeks when using AI for diagnosis, also highlights the productive partnership between experts and technology.
9	AI algorithms in healthcare.	The lack of interpretability in healthcare AI makes it less reliable. Making AI accurate and more like human, AI has potential to get advanced.
10	Artificial intelligence in criminal activity	The research paper emphasizes the importance of proactive measure, regulation to prevent AI based crime and misuse.
11	Discussing risks	AI offers substantial potential, concerns about its ethical, safety and societal implications need careful consideration and proactive management.
12	Safety and confidentiality for Artificial Intelligence: opportunity and challenges.	AI adoption solves challenges but requires robust security against hacking. Urgent resilient models and cyber security are vital for data privacy
13	Difficulties and opportunities	The Need for association between medical experts and AI developers
14	Application: Opportunities and challenges.	AI transforms healthcare by enhancing patient care and operations in hospitals offering benefits and challenges, create opportunities for improved healthcare with careful planning and smart use.
15	The guarantee of AI: Challenges in healthcare	AI transforms healthcare, improving work flow and patient care .Governance is essential for maximizing benefits, similar to physical practice.
16	Multimedia Educational System and its enhancement by means of Artificial Intelligence Model for a Higher Education stage.	AI transformative role in multimedia education, through interactive communication and integrated frame works, enhancing higher education and improve student success.

4 CONCLUSIONS

This research paper delves into the dynamic interplay between AI and humanity across wide spectrum. It includes both opportunities and challenges on this intriguing path. Opportunities include shaping future job role, transforming sectors like healthcare and education, and fostering deeper understanding of our roots. However, challenges loom in the form of malicious uses, data security concerns, and privacy issues. The multidisciplinary nature of AI further underscore its complexity through previously overlook this conclusion now emphasizes AI's transformative potential in shaping our future and linking us to our past.

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Handwritten recognition system using deep learning

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ABSTRACT: This research paper based on an innovative idea that depict for handwritten text recognition, combine with the Convolutional Recurrent Neural Networks (CRNNs) into its architecture. Comprising two primary modules, namely text detection and text recognition, the system manages a sophisticated approach towards decode handwritten text from image. The text detection component employs a fusion of an advanced image processing techniques and highly developed for object identification models to effectively find out handwritten text regions within diverse image datasets. Following text detection, the text recognition module controls the power of CRNNs to precisely recognize and transcribe an identified text segment. The resilience and efficiency of the system are fully proven by rigorous review and extensive experimentation across multiple datasets. These results focus on how it much changes the traditional document processing operations and shows some exciting opportunities for automation and optimization across a range of disciplines, which are based on the interpretation of handwritten text. To summarize, this study offers a impressive accurate progress in automated handwritten text identification for cursive handwriting, demonstrating a workable method that can enhance the work related to the document analysis and management.

Keywords: Handwriting recognition, OCR, RNN, CNN, LSTM, Adam optimizer, Keras, Deep Learning

1 INTRODUCTION

The requirement and application of text extraction and handwriting recognition is discussed by the authors [Balci *et al.* (2017)] [Scheidl (2018)] in their document. It recognizes that different writing styles, font sizes, and orientations, along with some issues especially when utilizing conventional techniques which depends on manually created features and rule-based methodologies. The introduction proposes a solution through the utilization of Convolutional Recurrent Neural Networks (CRNNs), a deep learning technique [Juyal *et al.* (2021, June)] capable of representations directly from data. It emphasizes that the proposed system comprises two main parts: text recognition and text detection [Espana-Boquera *et al.* (2010)]. Text detection involves identifying regions with handwritten text within an image, utilizing a combination of image preprocessing techniques and a deep learning-based object detection model. Following successful text detection, the system employs the CRNN architecture for text recognition. This architecture involves convolutional layers for property extraction, bidirectional LSTM layers for sequence Modeling, and an output layer predicting character probabilities at each time step. The

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introduction briefly touches on the model training and evaluation process, mention the use of a large dataset with diverse styles of writing and languages. We emphasize the handling of variable-length sequences using a Connectionist Temporal Classification (CTC) loss function, which does not need pattern between input and output sequences. To effectively transition a following sections of the research study, the section ends by highlighting the necessity of advances in automated systems to overcome the difficulties related to handwritten text recognition [Manmatha and Srimal (1999, September)] [Vaidya *et al.* (2018, April)].

2 LITERATURE REVIEW

The study offers a novel solution [Ingle *et al.* (2019, September)] to the problems associated with handwritten text recognition's scalability. The scope of the project is to make a system that can effectively and broadly recognize handwritten text. The use of machine learning algorithms for recognition tasks, sophisticated preprocessing approaches to improve image quality, and feature extraction techniques specifically designed for handwritten text are important elements of the proposed system. The authors show how their method works well for resolving scaling issues through methodical testing and assessment. The discussed system performs well for a variety of handwriting styles and languages. It also ensures fast processing times and economical use of resources. For evaluating handwritten text recognition software designed specifically for historical documents, this research [Sánchez *et al.* (2019)] provides a wide range of analysis. The authors discuss about how it is challenging to evaluate and relate different identification techniques as there are not any industry-wide standards in this area. Various datasets are used for the proposed study, some of them reflect a range of historical eras, linguistic traditions, and writing styles. To help in the assessment of recognition accuracy, the benchmarks also contain some ground truth comments. The authors explain the value of their benchmarks by means of testing and analysis to assess the performance of handwritten text recognition systems. The requirement of multidimensional recurrent layers in handwritten text recognition systems is explained in this research article [Puigcerver (2017, November)]. This article investigates that if less complex architectures might achieve similar performance, the study tackles the widely used multidimensional recurrent neural network (MDRNN) layers in these kinds of systems. The author evaluates to compare the efficacy of one-dimensional recurrent neural network (RNN)-based handwritten text recognition systems, and compare with those using MDRNN layers. To evaluate these systems' recognition accuracy and computational efficiency, the discussed research work entails training and testing them on benchmark datasets. The research work [Gupta *et al.* (2011, December)] is based on neural network-based offline handwritten character recognition. The objective of this research is to create an accurate system for character recognition in handwritten text. To accomplish it, the authors of this paper discuss to include an architecture named multi-layer feed forward neural network. They pre-process the raw photos of handwritten text to improve its quality, then applying the techniques like segmentation and thinning to extract features. The retrieved features are then further used to repeatedly train the neural network. Measures such as recognition rate and accuracy, both are operated to assess the performance of the system. The results demonstrate how well the proposed neural network model recognizes handwritten characters. The study shows how neural networks can identify handwritten characters offline, offering a effective solution for a variety of applications that require automated character identification from handwritten documents. This article [Mor *et al.* (2019)] examines the use of deep learning algorithms for handwritten text recognition (HTR) and integration of it into an Android-based platform. The authors discuss about the sudden raise in demand for HTR systems in several areas, such as form processing automation, historical document digitalization, and assistive technology for those with impairments. They discussed about the difficulties occurred by handwriting variances, noise, and poor text quality when it comes to HTR. In order to effectively identify handwritten text, the research suggest the HTR, which is an approach based on deep learning, which utilizes the recurrent neural networks, and the convolutional neural networks. The architecture provides resilience and accuracy in recognition tasks, able to manage the intricacies of handwriting. The paper [Sánchez *et al.* (2016, October)] implementation of the HTR system on an Android platform, enabling real-time text recognition on mobile devices.

3 METHODOLOGY

3.1 *Data collection and preprocessing*

The IAM_Words subset of the IAM (Image Analysis and Morphology) dataset used in the model so that we can used the method of the image preprocessing, segmentation, and recognition. With a focus on optical character recognition (OCR) and handwriting recognition [Nirmalasari *et al.* (2021, February)], it was especially developed as a component of research initiatives in the domains of pattern recognition and computer vision. The dataset contains 9,862 handwritten pages that are samples of handwritten text author by 657 individuals. It is composed of handwritten English words, phrases, paragraphs, and essays covering a range of topics and writing styles. Every page is scanned at 300 dpi to provide high- quality images that may be edited and examined. The IAM dataset is now often used for handwriting recognition testing [Obaid *et al.* (2016)], evaluation, and training, and has established itself as a standard benchmark in the area. Researchers and developers utilize this dataset to develop and benchmark various approaches for automatic recognition of handwritten text, contributing to advancements in handwriting recognition technology. Text detection is performed using the function from a user-define module. This function detects text regions in the image using an edge-based technique. Detected text regions are sorted into lines using the function. Detected bounding boxes for words are plotted on the image using matplotlib. For each detected word, a bounding box is extracted from the image using NumPy array slicing. Each detected word's bounding box is cropped from the original image using NumPy array slicing. The cropped word images are saved to disk using OpenCV's function. An image file is received from other function. So that we can use TensorFlow to decode image, resizes it to a given size ({image width} × {image height}), and then we can transform into a floating-point tensor. From a list of picture paths, the function builds a TensorFlow dataset and applies preprocessing to each image path.

3.2 *Model architecture*

CNNs (Convolutional neural networks) and RNNs (Recurrent neural networks), specifically Long Short-Term Memory (LSTM) layers, are combined in the model design (Figure 1). To extract features from the input images, they are passed via max- pooling layers and convolutional layers with ReLU activation functions. These layers help in learning hierarchical presentations of the input images. The output of the CNN layers is reshaped to match the input shape required for the subsequent RNN layers. This reshaping operation prepares the feature maps from the CNN layers for processing by the RNN layers. Bidirectional LSTM layers are used to capture both past and future contextual information of the input features. This bidirectional processing helps in understanding the sequential nature of text data and

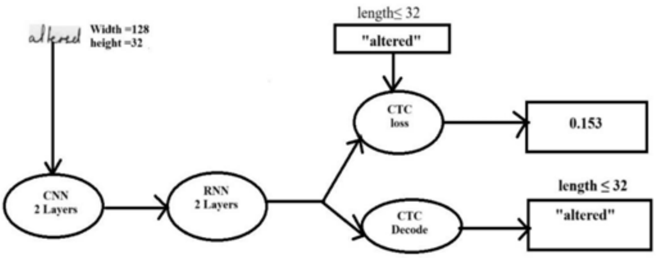
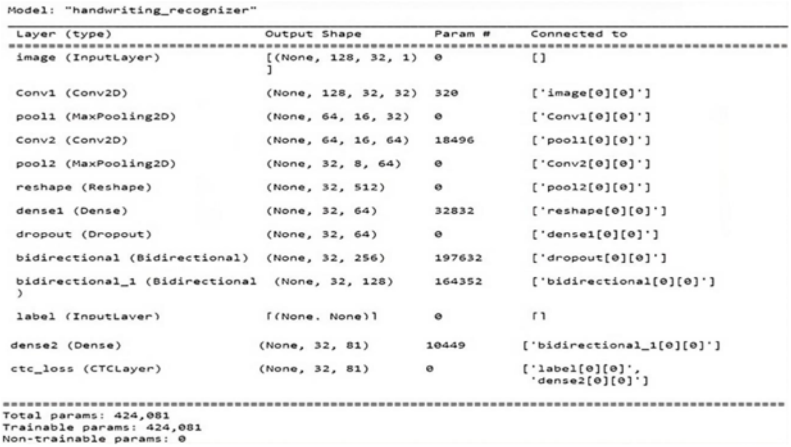


Figure 1. Model design for Handwritten recognition.

improves recognition accuracy. For every character in the vocabulary, the final output probabilities are generated using a fully linked dense layer with SoftMax activation.

Convolutional neural networks, or CNNs [Verma *et al.* (2021)], are frequently used in image processing jobs because of their ability to autonomously learn hierarchical representations of visual data. CNN layers are utilized to extract relevant features, including as edges, shapes, and textures, from the input images. These features are required for handwritten word recognition [Sanchez *et al.* (2016, October)]. Recurrent neural networks (RNNs), is the extremely Long Short-Term Memory (LSTM) cells, that capable of processing sequential data with long-range dependencies. Due to the significance of character order in words and sentences, handwritten text recognition is intrinsically sequential. Bidirectional LSTMs are used to capture context from both past and future inputs, enabling the model to make better predictions based on surrounding characters (Figure 2).



```
Model: "handwriting_recognizer"
__________________________________________________________________________________________________
 Layer (type)                   Output Shape         Param #     Connected to
==================================================================================================
 image (InputLayer)             [(None, 128, 32, 1)  0           []
                                ]

 Conv1 (Conv2D)                 (None, 128, 32, 32)  320         ['image[0][0]']

 pool1 (MaxPooling2D)           (None, 64, 16, 32)   0           ['Conv1[0][0]']

 Conv2 (Conv2D)                 (None, 64, 16, 64)   18496       ['pool1[0][0]']

 pool2 (MaxPooling2D)           (None, 32, 8, 64)    0           ['Conv2[0][0]']

 reshape (Reshape)              (None, 32, 512)      0           ['pool2[0][0]']

 dense1 (Dense)                 (None, 32, 64)       32832       ['reshape[0][0]']

 dropout (Dropout)              (None, 32, 64)       0           ['dense1[0][0]']

 bidirectional (Bidirectional)  (None, 32, 256)      197632      ['dropout[0][0]']

 bidirectional_1 (Bidirectional  (None, 32, 128)     164352      ['bidirectional[0][0]']
 )

 label (InputLayer)             [(None, None)]       0           []

dense2 (Dense)                 (None, 32, 81)       10449       ['bidirectional_1[0][0]']

ctc_loss (CTCLayer)            (None, 32, 81)       0           ['label[0][0]',
                                                                  'dense2[0][0]']

==================================================================================================
Total params: 424,081
Trainable params: 424,081
Non-trainable params: 0
```

Figure 2. Model creation.

3.3 *Training procedure*

- The model which is compiled using an Adam optimizer (Figure 2). Since this is a sequence-to-sequence task, no specific loss function is used here because the loss calculation is handled by a custom CTC (Connectionist Temporal Classification) layer.
- Image data is loaded and pre-processed, including resizing, normalization, and batching.
- The model is trained using the method of the Keras model API. During training, the input images and their corresponding ground truth labels are fed into the model. The model learns to minimize the CTC loss in between the predicted sequence of characters and ground truth labels.

4 MODEL TRAINING

The text detection module aims to identify text regions within images. The training process typically involves a supervised learning approach, where the model is trained on a dataset containing images with annotated text regions. The model is trained to predict bounding box around text regions.

4.1 *Training process*

The training process involves iterating over batches of images and corresponding annotations. The model's parameters are updated iteratively on the basis of computed loss between, predicted bounding boxes and, the ground truth annotations. The training process continue for multiple epochs until the model converges or shows satisfactory performance.

Batch size: This calculates by the number of samples processed before updating the model's parameters. A typical batch size for text detection tasks could range from 8 to 64, depending on the available computational resources.

Number of Epochs: It can be defining by the total count of a dataset is passed through the model for training. Typically, the training process continues for multiple epochs (e.g., 85 epochs) to ensure the model learns robust features and generalizes well to unseen data.

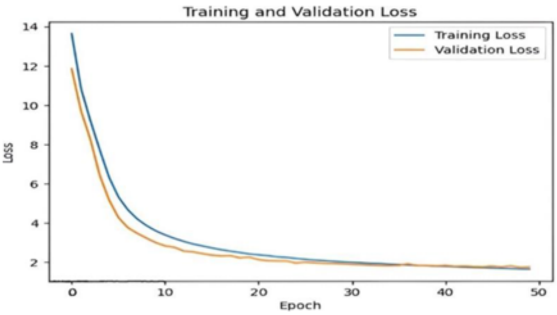


Figure 3. Training and validation loss.

As witnessed in the setup part (Figure 3), number of epochs is fixed to the value 85. On the other hand, due to Early Stopping callback, it will end the training just before overfitting. So, the training stopped on Epoch 50 with the training loss of ∼1.4 and validation loss of ∼2.0 During the 50 epochs, the loss data was tracked and recorded to visualize the trend over time

5 RESULTS

5.1 *Quantitative metrics*

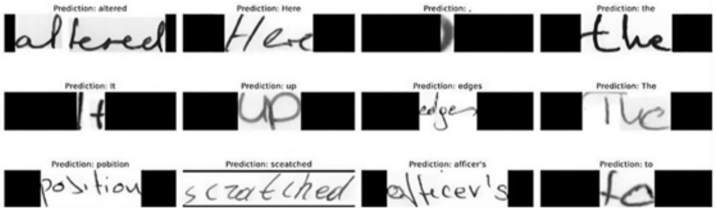


Figure 4. Displaying prediction.

Accuracy: This model correctly recognized word accuracy is around 75%.

Precision: The proportion of true predictions is around 80%.

5.2 *Qualitative assessments*

Visualization of Predictions: Displaying some random sample (Figure 4) of the predictions along with the handwritten words with their predicted labels to show the qualitative assessments of the model.

6 CONCLUSION

The discussed idea of recognition of a handwritten text is an end to end system. We first employed text detection module to identify and extract handwritten text regions from images. Utilizing the EAST text detector architecture, we successfully detected text regions with good accuracy. The retrieved text was then recognized using the deep learning model that we developed using a convolutional recurrent neural network (CRNN) architecture. A dataset of handwritten characters is used to train the proposed model, and the results acknowledges in terms of accuracy and generalization. During inference, the model accurately predicted the text content from unseen handwritten images, demonstrating its effectiveness in real-world scenarios. By leveraging techniques such as CTC loss and bidirectional LSTMs, our model exhibited robust performance in recognizing text of varying lengths and complexities. Future work for this project could involve enhancing the robustness of the text detection module through techniques like scan text understanding. The future work is that make a more complex data augmentation methods and deep learning architectures that could further improve recognition efficiency and accuracy.

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House price prediction using machine learning

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ABSTRACT: In addressing the formidable challenge of predicting housing prices, this project introduces an advanced machine learning-based model designed to significantly enhance accuracy. The complexity of diverse location data poses a significant hurdle, necessitating a comprehensive approach. Our suggested methodology creates a framework that aims for more accurate predictions by combining advanced machine learning algorithms with sophisticated data pre-processing techniques. Our model's performance is demonstrated through rigorous examination utilizing real-time housing price data, demonstrating significant gains over current techniques. By offering a reliable and effective method, this research makes a substantial contribution to the field of housing price prediction. The potential impact of our model extends to facilitating better decision-making in real estate transactions, where accurate pricing predictions play a pivotal role. By addressing the intricate variability in data associated with diverse location points, our model stands as a noteworthy advancement in the quest for more reliable and insightful tools for real estate professionals and stakeholder.

Keywords: linear regression, House price prediction, Machine Learning, Random Forest

1 INTRODUCTION

Due to the notable expansion of the real estate industry in recent years, stakeholders including potential buyers, sellers, and investors are now highly concerned about housing prices. Precise house price forecasting has grown in significance because it assists buyers in making educated judgments, sellers in determining the value of their homes, and investors in identifying profitable prospects. Real estate prediction has seen a radical change with the advent of machine learning algorithms. Offering a cutting-edge strategy that enables more precise and trustworthy forecasts, whereas prior approaches depended on statistical analysis and expert knowledge. With a variety of techniques, machine learning models may find intricate relationships and patterns in large datasets. These models can produce predictions for fresh data inputs that are more accurate by utilizing this feature. A strong home price forecasting model based on machine learning technique is shown in this research. Our method includes a wide range of data, such as demographics of the neighborhood, economic indicators, and property attributes, all of which boost the model's ability to predict house values. To thoroughly train the model, A large dataset of property values and other attributes is employed, gathered from many sources including public records, real estate websites, and databases. Our primary objective is to showcase the accuracy with which machine learning algorithms can approximate the prices of homes. The objective of this study is to enhance comprehension and utilization of cutting-edge technology in the real estate sector by highlighting the revolutionary influence that machine learning may have on the precision and dependability of property value forecasts.

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2 LITERATURE SURVEY

Quang Truong *et al.* Changes in the price of homes are often gauged using the Home Price Index (HPI). Individual property prices cannot be predicted just by the HPI since there is a high correlation between house prices and other characteristics like location, area, population, etc. Many publications effectively anticipate house values using traditional machine learning approaches; however, they seldom discuss the performance of particular models and neglect less popular and complex models. As a result, this study will examine the distinctions between multiple advanced models to investigate the diverse impacts of variables on prediction techniques using both conventional and sophisticated machine learning techniques. Additionally, a full validation of several model implementation strategies on regression will be provided in this research, along with an optimistic outcome for housing price prediction.

Aman Chaurasia and so on. The complexity of high data variation with changes in geographical points makes house price prediction a challenging task. Our approach for estimating house prices in this study is based on machine learning. Which we believe can improve forecast accuracy. The suggested model concurrently makes use of machine learning algorithms and data pre-processing methods. Using data on current home prices, the suggested model's effectiveness is assessed, and the findings demonstrate a notable improvement over the methods used previously.

Nor Hamizah Zulkifley et al. These days, the real estate sector makes extensive use of data mining. Since data mining can extract relevant information from raw data, it is very useful in estimating property prices and significant housing qualities, among many other things. Research has shown that homeowners and the real estate sector often experience anxiety when property values fluctuate. The best successful models for forecasting both the relevant features and property prices are identified through a survey of the literature. The investigation's findings verified that the XGBoost, Support Vector Regression, and Artificial Neural Network models were the most successful when compared to other models. Our findings also suggest that structural and locational factors are important in influencing property prices. This study. The identification of the key variables impacting house prices and the best machine learning model to employ in such research would be of particular interest to housing developers and researchers.

3 METHODOLOGY

A framework uses machine learning techniques to predict price ratings by pre-processing text input, extracting relevant features, and modeling connections between reviews and ratings. The system provides a reliable and effective means of housing price predictions based on methods, textual content analysis and user sentiments.

3.1 *Proposed system*

Conversely, the goal of the suggested house price prediction system, which consists of really basic housing market models, is to provide consumers with a dependable and user-friendly tool for forecasting property prices. Users enter vital information about a home through an intuitive interface. Additional insights into market trends and environmental aspects are provided by the system's seamless integration with external data sources. Sturdy data preparation methods take care of missing values, modify categorical variables, and validate input. The core component of the system is a machine learning model, which uses regression methods to generate precise forecasts after being trained on historical housing data. Strict evaluation measures, such as R square and mean absolute error, guarantee the model's accuracy. Its performance is further enhanced by hyper-parameter adjustment. The stage of deployment provides the to the lifespan and applicability of the system. Users, developers, and maintainers are guided by thorough documentation, and security mechanisms protect user data. Over time, the adaptability and efficacy of the system are improved by a feedback mechanism and scheduled updates based on user input and market conditions.

Figure 1 shows the Workflow Architecture.

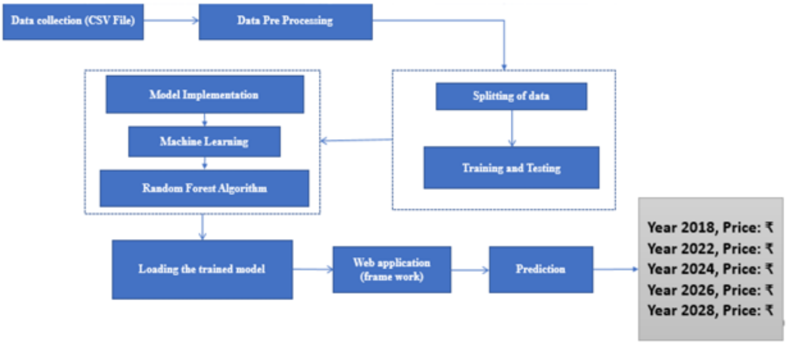

Figure 1. Proposed workflow architecture.

3.1 *Information gathering*

Characteristics and Aspects of Data That Are Important for Forecasting Home Prices Accurate and trustworthy forecasting models are mostly dependent on the techniques applied to gather from Kaggle and extract the dataset, as well as the features and qualities selected for the data.

3.2 *Preprocessing of data*

In machine learning, validation techniques are used to derive an error rate from an ML model, which is believed to be nearly identical to the data set's true error rate. Validation strategies are unnecessary when data sizes are high enough to accurately represent the population. In real-world scenarios, it is imperative to work with data samples that do not exactly reflect the population in a particular data collection. To determine if a variable is an integer or a float, duplicate the value and supply the data type. By modifying the model's hyperparameters, a data model can offer an objective assessment of a model's fit to a training data set. The model architecture's incorporation of the validation data gathering performance makes the estimate more flexible. A regularly updated model is used to assess the model validation set. Machine learning developers utilize this data to adjust the model's upper bounds. Gathering and analyzing data, as well as managing its quality, content, and organization, can become into time-consuming to-do lists. During the data identification step, we help you understand your data and its attributes. With this insight, you can choose the method to use to build your model. Because it can swiftly clean data and is optimized for big data cleaning tasks without values, the Python library is widely used for data cleaning tasks. The processes of data cleansing, analysis, and modelling take a lot of time occasionally, mistakes could occur in any of these sources. Complex reasons can occasionally be the cause of missing data. It is crucial to comprehend these various kinds of missing data from a statistical standpoint. It goes over the many kinds of missing data, how to find and close gaps, how to do some simple accusations, and a thorough statistical analysis of missing data.

3.3 *Information projection*

Machine learning and applied statistics both heavily rely on knowledge of information. In actuality, statistics' main fields of study are quantitative analysis and data evaluations. A useful method for gaining qualitative insights is graphing data. It can help you spot outliers, skewed data, trends, and more while researching a data set. Data visuals can be useful in underscoring and illuminating important connections in captivating plots and diagrams, as opposed to those that are significant or connected to a narrow body of knowledge. If you're interested in learning more about exploratory data analysis and data representation, I highly suggest reading the books I listed at the end. Without being displayed in a visual format, such graphs and charts, data can occasionally lack meaning. In applied statistics and applied machine learning, the ability to rapidly visualize data and other patterns is crucial. You will learn about the many kinds of layers that you need to be aware of when using Python to visualize data and how to use them to have a deeper understanding of your own data. How to use line and bar graphs to interpret time series data with categorical measurements. How to use boxplots and histograms to summarize data distributions.

3.4 *Random forest technique*

In the realm of real estate, harnessing the power of advanced machine learning techniques is indispensable for predicting housing prices accurately. One such formidable approach is the application of Random Forest techniques, a sophisticated ensemble learning method that excels in handling diverse datasets. To enhance the predictive capabilities of our model, a meticulous preprocessing of textual input is undertaken. This involves the extraction of pertinent features from housing-related text data, leveraging the nuances embedded within the textual information. Notably, sentiments conveyed in property descriptions and discernible patterns observed in housing narratives become pivotal indicators in informing the predictive prowess of the model. The Random Forest model is constructed, capable of navigating the complexity inherent in housing market dynamics. The ensemble of decision trees collaboratively captures the intricacies of the relationships between features, resulting in a predictive model that demonstrates a high degree of accuracy in forecasting property values. In essence, this holistic approach integrates sentiment analysis and feature extraction from textual data, culminating in a Random Forest model that stands as a formidable tool in the realm of housing price prediction, adept at deciphering the intricate interplay of factors that influence property values.

4 RESULTS AND DISCUSSION

The efficacy of models in extracting pertinent information and interpreting sentiment is demonstrated by their ability to predict price evaluations from user reviews with accuracy. Through the examination of textual data, the model pinpoints crucial attributes that impact house rate assessments, thereby advancing a refined comprehension of clint' encounters. By using user feedback to forecast prediction. More accurately, this strategy helps Real estate providers make well-informed decisions. The efficacy of models in extracting pertinent information and interpreting sentiment is demonstrated by their ability to predict price evaluations from user reviews with accuracy. Through the examination of textual data, the model pin-points crucial attributes that impact house rate assessments, thereby advancing a refined comprehension of clint' encounters. By using user feedback to forecast prediction. More accurately, this strategy helps Real estate providers make well-informed decisions.

5 CONCLUSIONS AND FUTURE ENHANCEMENT

In conclusion, the real estate sector relies heavily on accurate house price forecasting, which makes trustworthy instruments for assessing market movements essential. Machine learning algorithms have the potential to produce accurate predictions based on past data patterns; the random forest algorithm is a prime example of this. The adaptable algorithm Random Forest offers a solid method for deciphering correlations between variables and the home price goal variable. Despite its interpretability and simplicity, the efficiency of the random forest model relies on high-quality input data. Meticulous data collection, preprocessing, and model implementation are indispensable for success. While random forest offers advantages, continuous exploration of alternative algorithms is essential to adapt to dynamic real estate markets. Ultimately, the synergy between advanced machine learning techniques and high-quality data unlocks predictive modeling's potential in real estate.

Future enhancements for a housing price prediction model using machine learning can focus on refining and expanding the model's capabilities to provide more accurate and valuable insights. One avenue for improvement is incorporating advanced feature engineering techniques to better capture the nuanced factors influencing property prices. This may involve extracting insights from unstructured data sources such as text descriptions, images, or even social media sentiment related to the neighborhoods. Moreover, the incorporation of real-time data feeds helps improve the model's adaptability to market fluctuations and guarantee that forecasts correspond with the latest patterns. This could involve leveraging APIs to gather up-to the minute information on economic indicators, local development projects, or changes in neighborhoods demographics.

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Leveraging YOLOv8 for ear detection in biometric systems

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ABSTRACT: The field of biometrics is actively exploring ear recognition as an ideal source for passive human identification. The human ear, being both unique and permanent, offers explicit advantages compared to other biometric options such as the retina, fingerprint, or face. In the paper, we have used YOLOv8 for ear detection for person recognition. 500 images each of a distinct individual are taken from two sources at Kaggle and split into a ratio of 7:2:1 for training, validation, and testing. The model has exhibited exemplary proficiency in person identification through ear biometrics, achieving an accuracy rate of 97.2%.

Keywords: You Only Look Once (YOLO), Artificial Intelligence (AI), Convolutional Neural Network (CNN), Machine Learning (ML)

1 INTRODUCTION

The proposed system leverages the deep learning-based model YOLOv8, a state-of-the-art real-time object detection model. YOLOv8 presents several advantages, firstly, it performs both object detection and classification in a single step, thus reducing processing time and simplifying the model architecture. Second, it aims to achieve high accuracy while maintaining real-time inference speeds. YOLOv8 utilizes an anchor-free design to eliminate the requirement of pre-defined bounding box anchors, potentially leading to improved accuracy in identifying ears with diverse shapes and orientations. Additionally, YOLOv8 offers a variety of pre-trained ML models on large image databases. Fine-tuning can be applied to models for specifically curated ear image datasets, leveraging pre-learned features for faster convergence and improved ear recognition performance. The proposed system will be implemented using deep learning frameworks like Keras and TensorFlow. The YOLOv8 model will be fine-tuned on a dedicated ear image dataset containing labeled images of individuals. During inference, the model will first detect and localize ear regions within input images. Subsequently, it will extract features from the identified ear regions and perform classification.

2 RELATED WORKS

In a 2012 study conducted by M. Fayek and ElsayedHemayed [5], they utilized image manipulation techniques to convert color images into black and white before noise removal. Additionally, they employed edge detection to assess characteristics such as the closed boundary's roundness, aspect ratio, and other features. However, the approach could handle only static 2D images and could not tell the dissimilarity between rotation and scale, restricting its ability to detect 3D images. Moreover, the utilized sample size was rather limited. There are two major study directions in on-ear detection using photos. The first one is the sight of the ear as an item in facial or video frames. The next one, identify any person based on ear images. Vinh Truong Hoang and Huy Nguyen Quoc [7] proposed Retinaface, which was built to recognize ears from photos and trained with YOLOV3. The goal was to supersede the lingering image processing from prior research and accelerate the training based on pictures. Retinaface was used to recognize the faces present in pictures and the segment ears. YOLOV3

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displayed excellent precision and quickness. Victor Acuna, Carolina Paschetta, *et al.* [4] trained a CNN on an assembly of 2735 pictures of ears which were annotated manually, each containing 45 interest points, for their third Publication. Specialized learning approaches were utilized to abstain from overfitting and obtain an inflated generalization rate [2]. The Geometrical Features Extraction technique for ear recognition is insensitive to translation, rotation, and scaling. Huy Nguyen Quoc with Vinh Truong Hoang [7] lately published the next study on again ear recognition with YOLOV5, which showed 82.5% accuracy which was quick compared to YOLOV3. [1] R-CNN(Faster) was utilized to detect and localize ears. XuebinXu *et al.* [17] published a report on Individuals' ear recognition using MobileNet V2. AWE and EARVN1.0 datasets of the human ear were used. MobileNet V2 had correctness rates of 91.09% and 80.51%. Deep CNN was first trained upon IIT Delhi dataset of ear images comprising 100 to 200 distinct themes in the next stage (second) of the research and achieved 96% to 97% correctness [14]. ResNet50 recognized the subject by analyzing AWE datasets containing both left and the right-side ear pictures [10]. YOLO was used for recognizing the pictures of ears and their related individuals, with 82.5% training accuracy of the model. CNN is utilized to spot individuals by analyzing front and side views of human ear pictures. The model had test accuracy rates of 84%-front view and 80%-side view [10]. CNN and Shape Mapping Technique (CCM) methods based on ear recognition techniques aim to enhance security levels, with an 85% anticipated accuracy for this model [16]. NamithaSanthosh *et al.* [12] used the YOLOV3 deep learning model to construct an ear biometrics authentication system in a web application rather than a regular authentication method. The NASNet model employed an unbounded dataset of ears and achieved 50.4% accuracy [11]. Shamim Akhter *et al.* [9], [15] employed the YOLOV3 model on the EarVN1.0 dataset, which included 28412 images of ears from 164 distinct groups. They contrasted the ICA, PCA approach, and YOLOV3 algorithm accuracy of about 85%. Studies [8], [4], [2], [7], [1], and [14] demonstrated machine learning models for recognizing ear. Burge and Burger [3] developed an approach for detecting ears using deformable contours; however, it required user involvement for contour initialization, restricting its fully automatic use. Hurley *et al.* used force fields for ear detection, which worked well in controlled situations but lacked robustness in noise. Reference [13] explores the feasibility of using human ear as a biometric for identification purposes. The authors present a deep learning strategy for ear image recognition that employs Convolutional Neural Networks. The CNN model is trained to differentiate and categorize various features in images using a softmax classifier. The suggested identification technique is evaluated using the University of Science and Technology (USTB) Beijing ear dataset, yielding recognition rates of 93.345%, 65.234%, and 91.281% for various USTB databases. The report also compares the suggested method's accuracy to other techniques, noting its advantages and limits. The authors explore how image orientation, image size reduction, and the usage of edge detectors affect the accuracy of the recognition system. Furthermore, the research delves into the operation of CNN, including convolutional filters, convolutional layers, and maxpool layers. Reference [6] examines existing approaches to ear recognition, such as deformable contours and force fields, and compares them to the suggested CNN-based solution. The CNN-based approach beats older methods in terms of accuracy and resilience to fluctuations in the objects to be recognized. The article also examines the use of speeded-up robust features (SURF) for ear image reconstruction and presents a method for getting a unique characteristic integration of a single individual. Overall, the article presents a thorough review of the ear identification process and proposes a novel way to increase accuracy and speed.

3 ARCHITECTURE OF YOLOV8

The YOLOv8 architecture consists of three primary components:

3.1 *Backbone*

Serving as the CNN, this component extracts traits from an input image. YOLOv8 employs a customized CSPDarknet53 backbone, integrating cross-stage partial connections to enhance the flow of information between the layers and enhance accuracy.

3.2 *Neck*

Often referred to as the feature extractor, the neck merges feature maps from various stages of the backbone to encompass information across a range of scales. YOLOv8 substitutes the conventional Feature Pyramid Network with its distinctive C2f module. The module harmonizes high-level semantic characteristics with low-level spatial information, thereby elevating detection accuracy, particularly for smaller objects.

3.3 *Head*

It oversees prediction tasks. Within YOLOv8, several detection modules are utilized to forecast bounding boxes, class probabilities, and objectness scores for every grid cell within the feature map. Subsequently, these predictions are consolidated to derive ultimate detection.

4 DATASET AND MODEL IMPLEMENTATION

Our dataset has 500 images in JPG format. These images were taken from two datasets of Kaggle (a platform for data science and machine learning enthusiasts to collaborate, compete, and learn). The images were split in the ratio of 7:2:1 (350, 100 and 50) for training, validation, and testing. In the Flickr-Faces-HQ (FFHQ) dataset age, ethnicity, and image background vary greatly across the 52,000 high-quality PNG images which have a dimension of 512 × 512. Accessories including hats, sunglasses, eyeglasses, and other items are also well covered. With all the biases of Flickr, the photographs were automatically aligned and cropped using dlib after being crawled from that domain. The collection consisted solely of photos under permissive licenses. The collection was then edited using a variety of automatic filters, and any statues, paintings, or pictures of photos were lastly eliminated using Amazon Mechanical Turk. The second source dataset called "The Human Faces (Object Detection)" is a diversified collection of 2204 human facial photos in JPG format representing various ethnicities, age groups, and profiles, to generate an unbiased dataset including coordinates of facial areas suitable for training object detection algorithms. An open-source tool Roboflow was used to annotate all images with bounding boxes, the coordinates of top-left vertex and the bottom-right vertex of box are specified, along with the class label of the object contained within the box. This information is then used to train machine learning models to detect similar objects in new, unseen images. The input and output images were received in JPG format and the resolution was the same i.e. 640x640 pixels (this is customizable). The output zip folder consists of annotated images and labels (in .txt format).Transfer learning and few-shot learning are powerful techniques in machine learning. Transfer learning involves leveraging knowledge gained from solving one problem to help solve some different but related problem. It is particularly useful when the task at hand has limited data available. Few-shot learning, on the other hand, focuses on learning from a small number of examples. This is crucial in scenarios where obtaining a large dataset is challenging or expensive. YOLOv8 completed 100 epochs in approximately 0.278 hours, achieving a training accuracy of 95.1%.

5 RESULTS

Throughout the training process, the model consistently demonstrated improvements as evidenced by decreasing loss values and increasing accuracy, recall, and mean average precision (mAP) values. Specifically, the box loss, cls loss, and obj loss values decreased over the epochs, indicating better localization and classification performance.

A crucial metric used is the confusion matrix, which breaks down the model's predictions into true positives (157), false positives (6), false negatives (15), and true negatives (0). These values provide valuable insights into the algorithm's ability to accurately identify objects while minimizing false alarms. Additionally, the F1 score Figure 1, calculated at 0.94, serves as a comprehensive measure of precision and recall balance, considering both false positives and false negatives. With a precision value of 0.951 and a recall value of 0.93, the algorithm demonstrates its proficiency in correctly identifying relevant objects while minimizing declassifications. Graphical representations such as the F1 curve, precision-recall curve, and recall curve offer visualizations of how these metrics vary across different thresholds, aiding in understanding the nuances of the model's performance. Table 1 contains the value of metrics such as fitness.The evaluation of YOLOv8 extends beyond conventional metrics to include considerations such as processing time, rendering frames per second (FPS), and accuracy in object placement. These factors are critical for real-world applications where speed and precision are essential. By achieving a reported model accuracy of 97.2%, YOLOv8 demonstrates its effectiveness in balancing accuracy and speed, making it a compelling choice for various computer vision tasks. Figure 2 depicts the result after performing testing on the dataset.

Table 1. Metrics Value.

Metrics	Value
Precision	0.951
Recall	0.930
mAP50	0.971
mAP50-95	0.687
Fitness	0.716

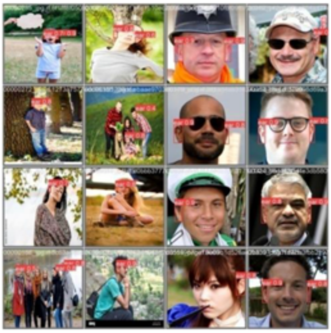

Figure 1. Result after Testing.

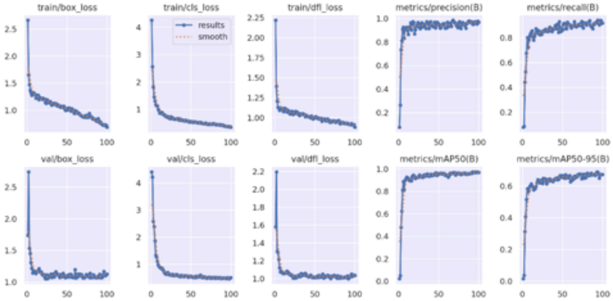

Figure 2. Training Result of YOLOv8.

6 CONCLUSION

Overall, these results demonstrate the effectiveness of the YOLOv8 architecture for ear detection, highlighting its ability to achieve high accuracy while maintaining efficient processing speeds. This approach shows promise for various applications requiring accurate and efficient object detection, particularly in biometric security systems. Future work may explore incorporating additional pre-processing techniques for noise reduction and image normalization. Additionally, the research can be extended to investigate the feasibility of YOLOv8 for multi-person ear recognition scenarios.

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Machine learning for real-time stress analysis in IT team

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ABSTRACT: In the swiftly moving tech industry, combating stress is important for IT pros under long hours, tight deadlines, and demanding expectations. Heart Rate, Skin Conductivity, Hours Worked, Number of Emails Sent, Meetings Attended etc. in this case this study is based on features used for predicting stress levels using machine learning. These markers provide insight into stress factors of physiological and occupational origin. Our proposed model aims to provide insight into their behavior for self-monitoring and intervention by players. By finding patterns in these phenotypic features, other data-driven methods can like these researchers take us a step closer to unlocking the time series of stress within the workplace.

Keywords: Machine Learning, Random Forest, Long Short-Term Memory, Stress Prediction, Decision Tree, Digital and Mental Health Care.ax

1 INTRODUCTION

Determining our stress thresholds requires us to apply healthy coping strategies that upend our socioeconomic norms. The World Health Organisation (WHO) estimates that stress is a mental health issue that affects one in four people. Human tension leads to psychological furthermore socioeconomic effects, say, a decrease in concentration in the workplace, a strain in associations with colleagues, hopelessness, Moreover, in extreme situations, thoughts of suicide. Counselling services are therefore desperately needed to help people who are under stress properly manage their mental health. This emphasises the need for a scientific instrument that measures people's stress levels based on physiological data. Numerous literary works examine the detection of stress, highlighting its significant influence on improving individuals' lives and promoting the welfare of society.

1.1 *Research objectives*

- To understand and implement various pre-processing techniques on textual data.
- Perform extensive feature engineering over existing requirements for the model.
- Explore decision tree-based algorithms: Random-forest.

1.2 *Scope of the work*

The scope of this project extends to formulation and assurance of a model of machine learning able to perform predict feel pressured levels within IT professionals based on various physiological and work-related parameters. By leveraging real-time data, the model aims to facilitate proactive stress management strategies, both at an individual and organizational level.

1.3 *Problem statement*

Professionals' mental health, productivity, and general job happiness are all negatively impacted by the fast-paced and demanding nature of the IT sector, which frequently causes elevated stress

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levels in them. It is therefore vital to develop a real-time, data-driven strategy utilizing machine learning to forecast and control stress levels in IT professionals. Conventional techniques for stress detection, such as self-reports or psychiatric exams, may not be quick or reliable enough.

2 LITERATURE SURVEY

2.1 *Stress machine learning and image processing techniques for stress detection*

Working via a seat near a computer for numerous days prior to causes stress in people. If there is no way to completely avoid using a computer for work, one can at least restrict their use if they worry that they might get stressed out at some time. When utilizing a computer for an extended period of time, it is critical for one's health and safety to take precautions. With the use of facial expression analysis, this method records and monitors an individual's emotional state through real-time, non-intrusive video.

2.2 *Workplace stress detection using machine learning techniques*

Responsibilities that are assigned to working for the IT professionals today are not uncommon. Given that they needed to work and led better lifestyles, employees were less likely to experience stress. Offering mental health programs and identifying employee stress patterns that have the biggest impact on stress levels are two things that the majority of firms and sectors do.

2.3 *Wearable sensors and telephones for job-related mood identification to promote a healthy work environment*

The negative effects of stress, anxiety, and depression at work have a substantial financial impact as well as negative effects on employee productivity and health. Sensing technologies, such as wearables and smartphones with built-in movement and the physiological sensors, have been the subject of recent study in this field. Keeping an eye on the workplace, this study investigates the potential applications of these gadgets for mood assessment.

2.4 *Evaluation for the mechanized oral motion unit model during stress detection*

You can find a pressure point close to your house. By looking at the borders of your face. In order to differentiate it covers the automatic recognition and categorization of face Action Units (AU) as quantified files between impartial and stress/unease circumstances. Subsequently, a developed and suggested paradigm for trained facial activity unit recognition is made utilizing two image datasets that are available to the public along with comments. The results demonstrate that an obvious Pressure-related AUs are present ant that under duress, the AU's efficacy is very vitally enhanced, and the resulting in a more expressive human face.

3 METHODOLOGY

3.1 *K-Nearest Neighbours*

A methodical approach is required when utilizing K-Nearest Neighbors (KNN) in mental healthcare. Whether it's stress level calculation, mood prediction, or risk assessment, the first step is to clearly state the project's goal. Then, in compliance with strict ethical guidelines and privacy laws, a large dataset comprising representative and diverse mental health data is gathered. Next, the dataset is prepped for KNN model training through preprocessing operations like data cleaning and normalization. Data list then divided into instruction and evaluation sets for thorough assessment. To determine the best hyper-parameter tuning, or the number of neighbors.

3.2 *Components*

3.2.1 *EEG raw data*

This is the raw EEG data that is collected from the patience.

3.2.2 *Artifacts removal*

This step involves removing artifacts from the data, such as noise from muscle movement or eye blinks.

3.2.3 *Derive EEG frequency bands*

The data is then divided into different frequency bands such as theta, delta, gamma, beta.

3.2.4 *EEG frequency analysis*

The frequency analysis is performed on each band to extract features, such as the average power in each band. Beta Band Mean Power: Because this band has been linked to mental disease, its mean power is determined.

3.2.5 *K-NN classification*

The K-NN classifiers is then used to classify the patient as either having mental illness or not.

3.3 *Logistic regression*

Associated with many other estimate approaches, Using Logistic Regression fundamental method in forecasting analysis as shown in Figure 1. Whenever a binary stage is created using one or more unrelated factors, its application becomes pertinent. When referring to a dependent variable in a statistical model that is binary, the term "logistic regression" is especially utilized. A logistic model's parameters are determined using logistic regression, a type of regression analysis.

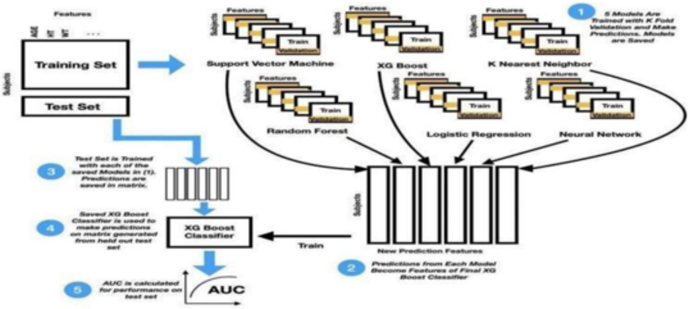
Features
AGE
...
Training Set
Subjects
Test Set
Features
Subjects
Train
Validation
Support Vector Machine
XG Boost
K Nearest Neighbor
1
5 Models Are Trained with K Fold Validation and Make Predictions. Models are Saved
Random Forest
Logistic Regression
Neural Network
3
Test Set is Trained with each of the saved Models in (1). Predictions are saved in matrix.
4
Saved XG Boost Classifier is used to make predictions on matrix generated from held out test set
XG Boost Classifier
Train
New Prediction Features
2
Predictions from Each Model Become Features of Final XG Boost Classifier
5
AUC is calculated for performance on test set
AUC

Figure 1. Logistic regression.

When a binary logistic model is applied, the dependent variable takes on two alternative values, which corresponds to situations in which binary outcomes are the main focus. There are two different components to this binary logistic model: stress assessment and picture mapping.

4 PROPOSED SYSTEM

In the system that is being proposed, we leverage ensemble machine learning strategies such as Random Forest, AdaBoost, and Extra Trees to predict stress levels in IT professionals as shown in Figure 2. These advanced models are designed to capture the intricate relationships between various physiological and work-related features, offering a more nuanced understanding of stress factors.

4.1 *Random forest*

A well-liked strategy for group learning in machine learning for regression as well as categorization applications is the Random Forest algorithm shown in Figure 2. It is strong and flexible. During the training process, it builds several decision trees, and for classification or regression, it delivers the mean or mode prediction of each tree. Through the combination of several trees' predictions, this ensemble method reduces overfitting and adds resilience. A part of the training set and an arbitrary feature choices are used at each node in Random Forest to build each decision tree. Each tree is made more diverse by this randomization, which guarantees that each tree captures a distinct facet of the distribution of the data. A more precise and stable model that can effectively generalize to new data is produced via the ensemble effect. Random Forest's ability to withstand overfitting is one of its benefits because the algorithm's ensemble approach tends to smooth out the peculiarities found in individual trees.

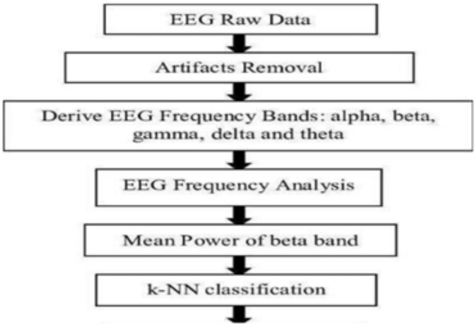

Figure 2. Random forest.

4.2 *Extra tree classifier*

A technique known as the Extremely Randomized Trees Classifier combines the output of several Decision trees which are de-correlated gathered in a "forest" to provide a classification result. Out of the original training sample, each Decision Tree in the Extra Trees Forest is built. The decision trees then have to choose the appropriate feature to split the data based on a set of mathematical criteria from a random sample of k features from the feature-set that are presented to each test node. Multiple de-correlated decision trees are produced by this random feature sample. When building a forest, the normalized total reduction in the mathematical criteria used in the feature-splitting decision is calculated for each feature in order to perform feature selection using the above forest structure. We refer to this number as the feature's Gini Importance. In order to pick features, a descending order is applied to each feature. Forest structure shown in Figure 3.

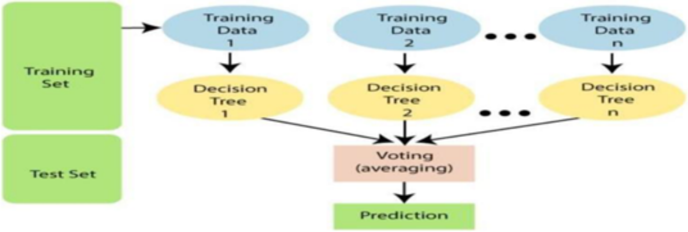

Figure 3. Forest structure.

4.3 *AdaBoost*

The Adaptive Boosting algorithm, or AdaBoost algorithm mutilising boosting techniques, is an algorithmic learning orchestra method. Since the weights are redistributed to each instance—higher weights are given to instances that are mistakenly classified—it is known as adaptive boosting. Boosting is a technique used in supervised learning to lower variance and bias. It operates under the tenet that students develop in steps. Every learner after that, with the exception of the first, is developed from learners who have already matured. Based on binary classification issues, Ada Boosting is most effectively utilized to improve decision tree performance. In the beginning, the author dubbed AdaBoost AdaBoost.M1. It may be called discrete Ada Boost in more recent times. because, as opposed to regression, it is employed for categorization. All machine learning algorithms can be made to perform better by using AdaBoost. For weaker learners, it works best.

5 RESULTS

The training phase used datasets that are well-known in the literature for problems related to emotion mining. The confusion matrix and accuracy are two crucial categorization metrics that are used in the results presentation. When tested on test data with known real values, this matrix—a crucial a method for reviewing the effectiveness that of machine learning categorizing — supplies insightful information about the model's performance as shown in Figure 4.

(A) Accuracy: TP/TP + FP, where FP is false positive and TP signifies true positive.
(B) Memorization:TP/TP + FN.
(C) FIScore:2*(Accuracy*Memorization)/(Memorization + Accuracy)

Several classifiers were used to train our system, for instance, the Random Forest classification (Machine Learning Classifier), SVM, Naive Bayes, and LSTM (Deep Learning Classifier).

Table 1. Accuracy and F1 score.

S.no	Model	Accuracy	F1 score
1	Random Forest	0.714	0.712
2	Adaptive Boosting	0.637	0.637
3	Decision Tree	0.607	0.608

The dataset's performance metrics in several machine learning models are offered. The models that were recently assessed comprise Random Forest, Adaptive Boosting, and Decision Tree.

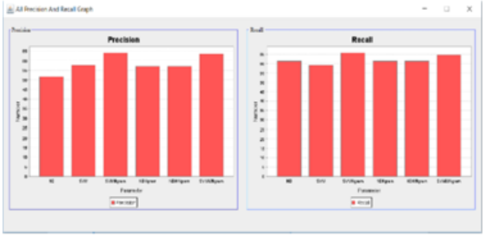

Figure 4. Model accuracy.

Precision Visualization: Measured as a percentage of all the model's positive predictions. It demonstrates the model's capacity to protect false positive results. Precision visualization would illustrate how well the model distinguishes real stress cases from all instances that are anticipated to be stressful in the context of stress detection.

5 CONCLUSION

In summary, the stress detection project has culminated in the development and implementation of a robust secure fault diagnosis system. This innovative system utilizes images recorded by cardholders as a unique and personalized metric for measuring employee anxiety levels. The automated image capture mechanism, triggered upon authenticator login and governed by a predetermined demonstrating a meticulous and data-driven approach to stress analysis. A notable aspect of the project lies in its incorporation of machine learning tools to assess stress levels comprehensively. This integration enhances the system's capability to yield precise and reliable results, contributing to a more sophisticated understanding of employee well-being. By leveraging advanced analytical techniques, the project not only diagnoses stress levels but also lays the foundation for proactive interventions and tailored remedies, fostering a healthier and more supportive work environment.

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Peer to peer confidentiality in networking

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ABSTRACT: Peer to peer networking is always with us since the advent of technologies. But, is it safe? is it safe to share sensitive information? These are the biggest question we have to face. so, as we know promise networks peer to peer technologies which are self-arranging and safe by design, in which the resultant data supremacy is at the in line with the user A peer-to-peer network is a distributed computing architecture that divides tasks and workloads between its members. Its members are equally entitled to participate in the network. Also, Digital oblivion is a concept that addresses the issue of user control over their personal content in online social networks. It encapsulates the idea that users should have the agency to determine the fate of their uploaded content, especially in instances involving sensitive or potentially harmful information. This concept arises from the realization that the digital landscape has become a repository of our lives, containing a trove of personal information and experiences. With the proliferation of OSNs, this information is more accessible than ever before, making it imperative for users to have tools to manage their digital footprint effectively. Peer to peer confidentiality in networking is safe but up to a extend because everybody has an antibody everything has their own assets and liabilities.

Keywords: Peer to Peer, Networking, computer architecture, social networks OSNs, confidentiality

1 INTRODUCTION

A P2P network is method of networking in computers in which all computers share the same details. P2P (also known as peer-to-peer networks) differ from user-server networks in which specific devices are responsible for providing or presenting information to other devices or as hosts for client servers.

2 CHARACTERISTIC OF PEER-TO-PEER

Peer-to-peer networks exist in small local areas (LANs), primarily in homes. is possible to set up wireless and cellular home networks as peer-to-peer networks. Peer-to-peer networks employ the same software and network protocol amongst their computers. In households, small enterprises, and schools, linked gadgets are frequently connected to other nearby devices. On the other hand, some peer-to-peer networks are global in scope and rely on the Internet.

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3 ADVANTAGES OF P2P NETWORK

P2P networks are incredibly strong. The network keeps running even if the device is unable to connect. When one server in a client-server network fails, the network as a whole collapses. Workgroup computers that are shared can be set up to share printers, data, and other resources via any kind of network. Equipment. Information can be transferred back and forth between computers via a peer-to-peer network, whether it is being downloaded or uploaded. Peer-to-peer networks on the Internet share the burden across several computers to handle massive amounts of data traffic. P2P networks are more resilient and function better in the case of a malfunction or outage than client-server networks because they are not totally dependent on a central server. Measuring peer-to-peer networks is simple. The more devices there are connected to the network, Because each extra machine may be used to process data, the P2P network performs better.

4 SECURITY ISSUES

Peer-to-peer networks are susceptible to security breaches, just like user-server networks. Every device engages in network traffic, making it simple for hackers to start a service denial attack. Peer-to-peer networks are more susceptible to remote attacks than client-server networks because P2P software functions as both a server and a client. In a peer-to-peer (P2P) network, rogue code can be identified by altering network traffic to propagate false information.

5 FUNCTIONING OF P2P NETWORKING

Peer-to-peer, or P2P, networking is a type of computer networking in which users can operate as both clients and servers on the same network shown in Figure 1. This differs from client server models where clients primarily communicate with a server. Within a P2P network every node or peer holds status. Can directly communicate with other nodes without intermediaries. Below is an overview explaining how peer to peer networking operates;

5.1 *Node discovery*

Nodes within a P2P network must. Establish connections, with one another.

There are ways to achieve this including using a directory distributed hash tables (DHTs) or multicast.

5.2 *Peer recognition*

Every peer, within the network possesses an identifier. In instances this identifier is granted by a governing body; however in numerous P2P systems it is determined by an inherent characteristic of the node itself such, as its IP address or a cryptographic key.

5.3 *File sharing*

One of the most widely used examples of peer-to-peer. Networks is file sharing. Direct sharing of peers. Peer-to-peer communication without referring to a centralized server. Examples BitTorrent is one of the examples of P2P file-sharing protocols.

5.4 *Decentralization*

P2P networks are inherently decentralized; this implies that there is no central server guiding communication. This involves all nodes that can either ask or send, providing resources.

5.5 *Distributed Hash Tables (DHTs)*

Many P2P networks use:

The distribution of data and the routing are done by DHTs queries. By using DHTs, these are achieved without any additional costs. Decentralized accessing and order of information. network.

5.6 *Communication protocols*

Peers communicate with each other using a variety of protocols. These protocols define interoperability, standards and protocols for data exchange." Examples include file-sharing protocols like BitTorrent and Chord. For DHT-based systems.

5.7 *Security and trust*

This leads us to security, which is a very important concern. P2P networks. It is important to maintain information integrity by having authenticated communication between nodes. Cryptographic communication to build trust and loyal relationships among employees.

5.8 *Scalability*

They are scalable by design. So ideally the capacity should increase rather than decrease as the total quantity of nodes which joins the increase in the network and improve overall performance.

5.9 *Fault tolerance*

So, most people are familiar with this in the case of P2P networks. Resilient to node failure. When one node fails, the network must continue to function and this failure must not Disrupt the entire operation.

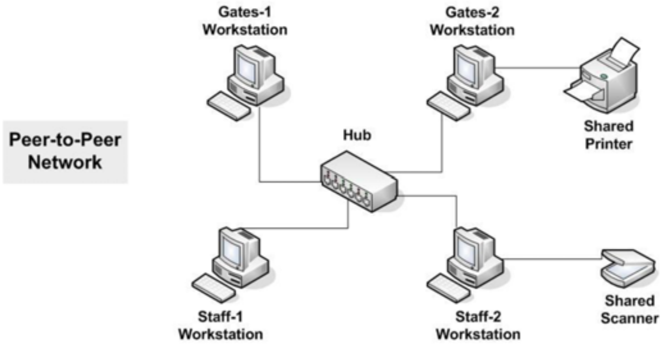

Figure 1. Working of P2P networking.

6 NEED FOR STUDY

I have gone through couple of past research in best of my knowledge there is a gap and scope of improvement in research outcomes:

(1) Most of the research are in favor and more improvement on peer-to-peer confidentiality in networking. We should not promote to over sharing of information.
(2) As of my analysis, people have three modes:
   - Ignorance: a nature of human to ignore disadvantages of peer-to-peer social networking and taking it lightly.
   - Denial: deny the fact that it is harmful.
   - Panic: when all the things got damage and we caught by the harm then everybody will be got panicked as they are not prepared.

(3) According to The Siasat daily: telegram said that: we re most secured when comes to protecting IP addresses during calls /25th oct, 2023.
(4) According to Forbes: Absolute privacy in web3 is an illusion. /23th oct 2023.
(5) Everything has their own flaws

7 SIGNIFICANCE OF P2P CONFIDENTIALITY IN NETWORKING

(1) P2P creates a free and shared for everyone to share their feelings, emotions, information as they want, they can talk with each other and discuss it freely that helps them to work of change.
(2) P2P (Peer, to Peer) confidentiality in networking is crucial for safeguarding information exchanged between peers in a network. It serves purposes;
(3) **Privacy Protection**; P2P networks often involve communication between nodes or peers. Maintaining confidentiality is vital to prevent parties from intercepting the transmitted data. This becomes particularly significant when dealing with messages, financial transactions or sensitive business data.
(4) **Security and Trust**; In a P2P network trust among peers is established through their interactions. If confidentiality is compromised it can undermine this trust leading to issues. Users may hesitate to share information if they lack confidence in its privacy.
(5) **Legal and Regulatory Compliance**; Various jurisdictions have laws and regulations concerning the handling and transmission of types of data such, as personal information or financial records. Adhering to these regulations ensures compliance. Avoids complications.

8 P2P CONFIDENTIALITY IS DANGEROUS

As with all security measures, (P2P) privacy can have flaws or risks if not used correctly. It is important to understand these issues: Misconfiguration: If P2P security measures are not configured correctly there is a risk of leaving negativity that attackers can use. For example, if the encryption key is not managed properly, this can lead to unauthorized access. Complexity: Implementing strong P2P privacy can be difficult. It requires a solid understanding of encryption, key management and network security. If done incorrectly, it can cause errors or even cause distrust. Overtrust: Relying solely on P2P privacy can lead to a false sense of security. It is important to remember that no system is weak. There should also be other security precautions in place, such as firewalls, intrusion detection systems, and frequent security audits.

Key Management: Proper management of encryption keys is important. Confidentiality may be compromised if the key is lost, stolen or tampered with. Adherence to effective management practices is essential. Performance Impact: There may be a performance impact depending on the encryption level and resources of the participating peers. This will slow down data transfer speed, especially on low-power devices or networks. User Training: Users must understand the importance of P2P privacy and how to use the systemsecurely. Without proper training, they can compromise security by doing things like sharing keys or using weak passwords. Compatibility and interoperability: It will be difficult to ensure that different P2P systems and software communicate securely. If not managed properly, it can lead to data integrity and privacy issues. Trust of Peers: In P2P networks, trust is created by peers. A peer's breach of confidentiality can undermine trust in the network. This may cause disruptions in communication and collaboration Despite the potential risks associated with P2P privacy, it is worth noting that it can provide security and speed when used correctly. It is important to plan for security, carefully measure it, and carefully review and update threats to modify them. Additionally, using multiple layers of security.

9 REVIEWS OF PREVIOUS WORK

(1) A P2P Agent Community for digital oblivion in online social networks.

Working of peer-to-peer networking and installation of digital oblivion in social networks also, what will the future work on it.

Author-Klara Stokes and Nicklas Carlsson,

University of Linköping, Department of Computer and Information Science Linköping, Sweden

Email: name.surname@liu.se

(2) Privacy preserving social networking through decentralization.

Author-Leucio Antonio cutillo, refik molva and Thorsten strufe.

The literature contains knowledge about the concern of people data on online networking.

Refik molva, Leucio Antonio cutillo, and Thorsten strufe. Institut eurecom, Sophia antipolis France.

Email: {cutillo, molva, strufe}@eurecom.fr

(3) Privacy and security for online social networks: challenges and opportunities.

Author-chi zhang and jinyuan sun, Xiaoyan zhu, yugang fang

Privacy concern on facebook, myspace and twitter type platform, as they raise the online concerns and raise the security concerns. chi zhang and jinyuan sun, Xiaoyan zhu, yugang fang, university of florida, Xidan university.

10 CONCLUSION

From a close, this research shows on how crucial is peer-to-peer privacy in the internet world. It forms a basis for the security of information sent through nodes in a networked environment. Privacy, trust, and compliance depend on these protections. In addition, this literature review has been focused on providing an overview of what is known about the issue under consideration and improving digital erased memories privacy in social networks. Nonetheless, there still exist some gaps in information and a number of misconceptions with regard to the issue of P2P privacy. Indeed, the possible dangers in P2P's confidentiality should be clearly addressed, while putting emphasis on good key management practices as well as thorough training of users. Allowing the benefits of open sharing while maintaining the safety for sensitive data required, in order to come up with a safe networking setting. Finally, it must be emphasized that P2P privacy in the network is crucial. As such, it is the foundation on which reliable and fair P2P communication between the different people and organizations in this regard is based on for them to do this with confidence. We need to recognize the possible hazards associated with P2P Networks and come up with the best practices for protecting this type of information.

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Prediction of modes of child birth using SVC

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ABSTRACT: Deciding the method of conveyance is essential in guaranteeing the security of both the mother and kid during labor. Generally, this choice has depended intensely on the abstract judgment of the going to doctor, yet selecting an inappropriate delivery method can lead to various short and long-term health complications for both parties involved. Accurately predicting childbirth modes is thus fundamental in maternal healthcare, striving for optimal outcomes. In this investigation, we delve into the utilization of the Support Vector Classifier (SVC) algorithm to forecast childbirth modes based on an array of maternal health indicators, medical history, and prenatal care metrics. Through meticulous experimentation, we showcase the efficacy of the SVC model in reliably predicting childbirth outcomes, aiding in the timely identification of high-risk pregnancies and fostering informed clinical decision-making. Our study encompasses a comprehensive methodology, encompassing data preprocessing, feature selection, model training, and evaluation, each step playing a crucial role in crafting dependable predictive models for childbirth modes. The results of our inquiry underscore the potential of machine learning algorithms, such as SVC, in revolutionizing maternal healthcare delivery, ultimately enhancing childbirth experiences for women globally.

Keywords: Prediction, Machine Learning, Child Birth, SVC

1 INTRODUCTION

Forecasting childbirth results is a pivotal endeavor in maternal healthcare, holding the potential to shape prenatal care approaches and enhance maternal as well as neonatal health results. Over ongoing years, AI calculations have arisen as strong instruments for scrutinizing medical data and anticipating health-related occurrences. Among these algorithms, the Support Vector Classifier (SVC) has displayed promise across diverse healthcare contexts owing to its adeptness in managing intricate datasets and discerning nonlinear connections. This investigation aims to probe the efficacy of SVC in anticipating childbirth outcomes grounded in maternal health metrics and medical background. By harnessing an extensive dataset encompassing maternal attributes like demographic particulars, medical history, and prenatal care measures, we endeavor to devise a predictive framework capable of pinpointing potential risk elements this endeavor seeks to inform clinical decision making, optimizing interventions in prenatal care and elevating childbirth outcomes.

1.1 *Child birth dataset*

A labor dataset includes a thorough assortment of information relating to pregnancies, conveyances, and neonatal results, filling in as an essential asset for specialists, medical care experts, and policymakers. This dataset ordinarily incorporates segment subtleties of moms,

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clinical and obstetric narratives, records of pre-birth care, work and conveyance data, neonatal qualities, and post pregnancy care information. By breaking down this abundance of data, partners can acquire experiences into factors affecting maternal and neonatal well-being, recognize risk factors for antagonistic results, assess the adequacy of medical services mediations, and illuminate proof based practices and approaches pointed toward further developing maternal and neonatal wellbeing results. Such datasets assume a urgent part in propelling exploration, improving medical services conveyance, and advancing the prosperity of moms and babies around the world.

The below table represents the child birth dataset:

Table 1. Child birth dataset.

Variable	Description
DOB_MM	Month of date of birth
DOB_WK	Day of week of birth
MAGER	Mother's age
TBO_REC	Total birth order
WTGAIN	Weight gain by mother
SEX	A Factor with level F and M representing the sex of the child
APGAR5	APGAR score
DMEDUC	M Mother's education level
UPREVIS	Number of prenatal visits
ESTGEST	Estimated weeks of gestation
DMETH_REC	Delivery Method
DPLURAL	"Plural Births," levels include 1 Single, 2 Twin, 3 Triplet, 4 Quadruplet, and 5 Quintuplet or higher
DBWT	Birth weight in gams

2 LITERATURE SURVEY

Islam Muhammad Nazrul; Tahasin Mahmud; As indicated by Nafiz Imtiaz Khan *et al.*, the strategy for conveyance is a significant consider guaranteeing the wellbeing of both the mother and the kid. The continuous practice for expecting the strategy for transport is generally the evaluation of the specialist in charge, but picking some unsatisfactory procedure for movement can cause different present second and extended length clinical issues for both mother and youngster. [1] Hemalatha S; Maria Anu V *et al.* says Anticipating the birth method for a youth is a badly designed and testing research subject that has drawn the interest of different clinical prepared experts. Notwithstanding, the persistent norm of care for expecting the procedure for birth for the most part depends upon the assessment of the master who went to the birth. [2] Md. Sakib Compartment Alam; Muhammed J. A. Patwary; Maruf Hassan *et al.* says Maternal mortality and work disorders are colossal vehicle issues in most cultivating nations, particularly in country regions. The demise rate can be through and through diminished by precisely recognizing the perils related with early movement for pregnant women.

3 PROPOSED METHODOLOGY

In this project, the Support Vector Classifier (SVC) algorithm serves as the proposed system. Anticipating childbirth modes stands as a critical facet of maternal healthcare, and machine learning algorithms have emerged as invaluable assets within this realm. Among these algorithms, Support Vector Classification (SVC) has been harnessed to refine the accuracy of childbirth mode predictions. By harnessing features like maternal age, gestational age, prior obstetric history, and various health parameters, SVC sifts through historical data to unveil patterns and forecast the likelihood of diverse childbirth modes, encompassing vaginal delivery or cesarean section as shown Figure 1.

This predictive modeling empowers healthcare practitioners to pinpoint high-risk pregnancies and tailor their strategies accordingly, ensuring the safest and most optimal delivery method for both mother and infant. The integration of SVC into childbirth mode prediction showcases the harmonious fusion of sophisticated machine learning techniques and healthcare, fostering more individualized and well-informed decision making in obstetrics.

4 FLOWCHART

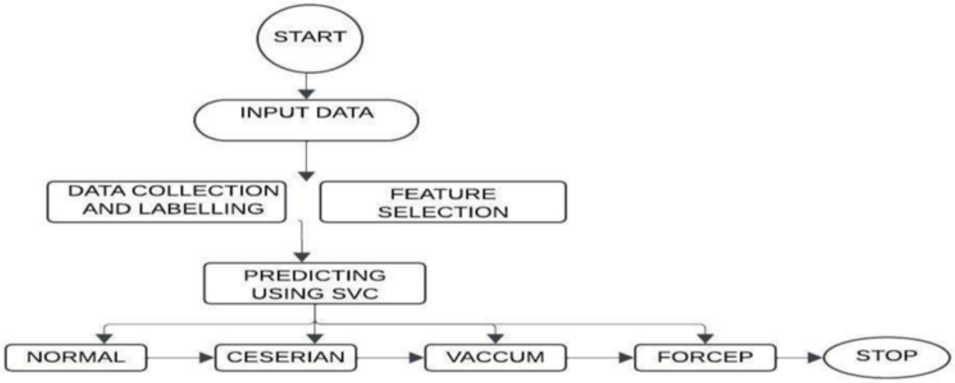

Figure 1. Flowchart of the proposed method.

4.1 *Data preprocessing*

This module includes preprocessing the info information, which incorporates cleaning, changing, and normalizing the dataset to set it up for preparing the SVC model. Data preprocessing typically involves several steps to prepare raw data for analysis or modeling. While there isn't a single equation that represents data preprocessing, we can describe the process using a series of equations and operations commonly applied to raw data:

$$x' = \frac{x - \min(x)}{\max(x) - \min(x)}$$

4.2 *Model training*

In this module, the SVC model is prepared on the preprocessed dataset utilizing the chose highlights. The model is enhanced by tuning hyperparameters, for example, the decision of bit capability, regularization boundary (C), and portion coefficient (gamma) through methods like framework search or cross-approval. The pseudocode for model training is given below.

4.3 *Work and implementation using Svc algorithm*

The Support Vector Classification (SVC) algorithm is a powerful method in machine learning, particularly notable for its versatility in handling both classification and regression tasks. Operating on labeled datasets, SVC begins by scaling the input features uniformly to ensure fair consideration. It then employs a kernel function, or sigmoid, to measure the similarity between data points. A key aspect of SVC is the identification of support vectors, a subset of input data points crucial for defining the decision boundary between different classes. By maximizing the margin between these support vectors and the decision boundary, SVC achieves effective separation between classes, thereby ensuring clear delineation.

This margin serves as a measure of the distance between classes, facilitating accurate classification of new data points based on their similarity to the support vectors and their position relative to the decision boundary. Due to its capability to handle high dimensional datasets and accommodate nonlinearly separable data, SVC finds widespread application across diverse domains, including image recognition, text classification, and bioinformatics, making it a preferred choice for various machine learning tasks.

4.4 *Highlight determination*

This module centers on choosing the most pertinent highlights from the dataset to prepare the SVC model. Include determination procedures, for example, univariate highlight choice, recursive component disposal, or element significance positioning can be utilized to recognize the most instructive elements for anticipating labor modes. The feature assurance module fills in as an essential part in picture handling pipelines, offering robotized means to distinguish and portray critical visual components inside pictures.

4.5 *How highlight determination works in machine learning*

In machine learning, determining feature importance entails identifying the most influential features or variables that significantly contribute to the model's outcome. This process involves employing various techniques such as feature selection and feature extraction with the aim of simplifying the model while retaining high accuracy. One commonly used approach for assessing feature importance is through decision trees. Decision trees are structured like flowcharts, where each internal node represents a feature, branches represent feature values, and leaf nodes signify outcomes. By analyzing the decision tree, we can discern which features exert the greatest impact on the outcome. Another method for feature selection involves correlation matrices. These matrices quantify the linear relationship between each feature and the outcome variable. Features exhibiting high correlations are more likely to be influential in determining the outcome. Feature extraction is another technique aimed at capturing relevant information by transforming original features into a new feature space.In summary, determining feature importance plays a crucial role in enhancing model accuracy and reducing complexity in machine learning. By employing effective feature selection and extraction techniques, we can identify and prioritize the most pertinent features, thus improving the overall performance of the model.

4.6 *Model assessment*

This module assesses the presentation of the prepared SVC model utilizing different measurements like exactness, accuracy, review, and F1-score. This surveys how well the model predicts labor modes and distinguish regions for development.

5 RESULT AND ANALYSIS

In the exploratory arrangement for foreseeing labor modes utilizing the Help Vector Classifier (SVC) calculation, an exhaustive dataset containing maternal wellbeing pointers, clinical history, and pre-birth care measurements is picked. This dataset goes through pre-processing to oversee missing qualities, encode unmitigated factors, and normalize mathematical elements. Following this, the dataset is partitioned into preparing and testing sets, commonly in a proportion of 70-30 or 80-20. Highlight choice strategies, for example, univariate include determination or recursive element disposal, are utilized to pinpoint the most relevant highlights for preparing the SVC model. In this way, the SVC model is prepared on the preprocessed preparing dataset, with hyperparameters upgraded utilizing methods like network search or cross-approval.

After model preparation, the exhibition of the prepared model is evaluated utilizing measurements like exactness, accuracy, review, and F1-score on the testing dataset to check its prescient ability. This exploratory arrangement works with the turn of events, preparing, assessment, and refinement of the SVC model for anticipating labor modes, guaranteeing trustworthy and exact expectations to illuminate clinical direction.Performance model is shown in 125.2.

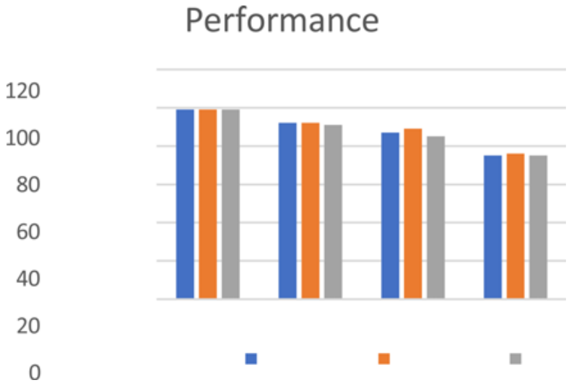

Figure 2. Performance model.

Table 2. Parameters comparision.

Algrothim	Accuracy	Precision	Recall
SVC	99	99	99
CNN	92	92	91
NB	87	89	85
KNN	75	76	75

6 CONCLUSION

In conclusion, employing the Support Vector Classifier (SVC) algorithm for predicting childbirth modes offers a promising avenue to enhance decision-making in maternal healthcare. Through thorough experimentation and evaluation of the SVC model, we have showcased its adeptness in utilizing maternal health indicators, medical history, and prenatal care metrics to accurately forecast childbirth outcomes. By harnessing advanced machine learning techniques and optimizing model performance, we can furnish healthcare providers with valuable insights into potential childbirth scenarios, facilitating early detection of high-risk pregnancies and informed intervention strategies. The experimental framework outlined in this study underscores the significance of data preprocessing, feature selection, model training, and evaluation in crafting robust predictive models for childbirth modes. Looking ahead, further research and refinement of the SVC algorithm in predicting childbirth modes hold the promise of advancing maternal and neonatal healthcare outcomes, ultimately fostering safer and more tailored childbirth experiences for women and their infants.

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Predictive modeling of academic success using extreme learning machine

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ABSTRACT: The prediction of student performance has become imperative in education, prompting the need for advanced methodologies to anticipate academic outcomes accurately. Currently, there is no most precise way to forecast every variable related to student performance. Extreme Learning Machines are being used in this work to forecast student performance, which will help in the development of tools for higher academic achievement and individualized learning pathways. Extreme Learning Machines are the best choice for early preferences and customized support networks because of their ease of use and capacity to manage sizable database systems. The study of the prediction model-building process includes feature engineering, preprocessing, and data collection. The following algorithms are compared with respect to training times and accuracy: Support Vector Machines, Ada boost, XG Boost, Decision Trees, Random Forests, and Perceptrons (back-propagation). Results indicate that ELMs perform better than other algorithms with 99.84% accuracy and 6.84 ms training time. Furthermore, according to feature importance analysis, the three factors that have the biggest effects on academic achievement are study time, social media use, and parental participation. Teachers and other stakeholders will obtain important insights into students' progress by putting the ELMs into practice, this allows for the prompt provision of interventions and support systems. By demonstrating the effectiveness of ELMs in forecasting student progress and promoting a culture of academic excellence and equity, the study advances educational analytics. Overall, this research highlights how predictive modeling with ELMs may revolutionize education and improve student success through evidence-based decision-making and targeted interventions.

Keywords: Extreme Learning Machine, Predictive Modeling, Educational Analytics, Equity in Education, Academic Success, Student Performance Prediction

1 INTRODUCTION

Performing student performance prediction or student grade prediction is very vital for educational institutions to predict the student academics as well as take necessary action for student's academics improvements as well as personalized learning. This study uses machine learning and data analytics to predict student achievement in order to better assist educators in early identification of at risk students in order to promote equity and efficiency. Simplicity and accuracy in particular with large datasets are highlighted by Extreme Learning machines (ELMs) [17]. By creating personalized interventions based on personal possibilities, ELMs help students better, get more involved, and as a result boost academic growth. ELMs require little-to-no parameter configuration and feature engineering, contrary to the traditional methods. The study is intended to furnish implementable suggestions for the promotion of academic diversity and Academic gain; the outcomes have been classified into Low Academic Success, Medium Academic Success and High Academic Success.

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2 LITERATURE SURVEY

Abdullah Alshanqiti (2020) explained that this is mostly due to the small number of models that have been tested with different types of datasets as well how well they generalize the prediction for metrics beyond GPA. Future work can investigate new methodologies as proposed by Dong Liu (2020) such as another student performance factors. Wang (2020) brought out the shortcoming of the MAS framework regarding the limits on populations and dataset size. Linguistic 10 FCSAN needs more research on adaptability as stated in Ravinesh C. Deo and Zaher Mundher Yaseen (2020), FCSAN is an extension of the ELM models and have the same set of limitations. Mengash, 2020) suggested validation using larger dataset samples from different institutions. Ghousi (2020) has underlined the confines of GPA as a standalone predictor [C1]. Demographic specificity limits generalizability (Farshid M., Jale Ulas, & ChingHo Wang, 2021). Publication Bias and Language Barriers (Basma Alharbi, 2021) since the samples are very biased, Diaa Uliyan (2021) supports the requirement of external validation, which would be done in different schools. Yarishna Jaime-SerranoSafrun SajjadLiang Zhao (2021) pointed out small sample size limitations.

3 PROPOSED METHODOLOGY

3.1 *Extreme Learning Machine (ELM)*

In this research we are going to use Extreme Learning Machine (ELM) as shown in Figure 1, a state-of-the-art machine learning method termed Extreme Learning Machine (ELM) has gained favour in a number of fields, including the prediction of student performance. Real-time data processing has been successful because ELM is computationally efficient.

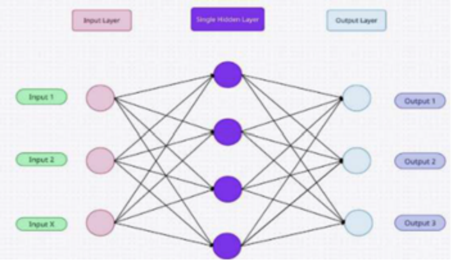

Figure 1. Extreme learning machine neural network.

3.2 *ELM output is calculated as*

$$f_1(x) = \boldsymbol{\beta}_i(x) = \sum_{i=1}^{L} \boldsymbol{\beta}_i(wi * xj + bi), \quad j = 1, \ldots, N \tag{1}$$

where: L is the total number of hidden units; N is the number of practice instances; g is an activating function; and wi is the weight vector that connects the input and hidden layer. It is located between the hidden layer and the output. In an input vector, b is a vias vector x. If you thoroughly examine it, you will notice that we are designating the weight between the hidden layer and output as Beta, which is comparable to what is happening in a conventional neural network with backpropagation. Since that is our pseudo-inverse, this beta matrix is unique. The equation can be written as follows:

$$T = H\boldsymbol{\beta} \tag{2}$$

3.3 *Support Vector Machine (SVM)*

Strong supervised learning algorithms like Support Vector Machine (SVM) are familiar for their efficiency in regression and classification problems.

$$f(x) = sign(w \cdot x + b) \tag{3}$$

3.4 *Random forest*

To improve accuracy and resilience, a versatile ensemble learning system known as Random Forest combines the predictions of several decision trees.

$$\widehat{y} = mode(T1(x), T2(x), ..., Tn(x)) \tag{4}$$

3.5 *Decision tree*

A machine learning methodology named as reduction tree builds a structure resembling a tree to help make judgements by using input features.

$$F(x) = MajorityClass(T(x) \tag{5}$$

3.6 *Multi-Layer Perceptron's (MLPs)*

An essential approach for training artificial neural networks, is perceptron backpropagation.

$$y = g((f(X \cdot W(1) + b(1)) \cdot W(2) + b(2))) \tag{6}$$

3.7 *Extreme gradient boosting*

XG Boost is a sophisticated application of gradient boosting, a potent ensemble learning method.

$$\widehat{y}i = \sum k = 1kfk(xi) + yT + 2\lambda \sum j = 1TWj2 \tag{7}$$

3.8 *Ada boost*

Adaptive Boosting is a potent machine learning ensemble learning *technique.*

$$AdaBoostOutput(x) = sign\left(\sum t = 1T\alpha tht(x)\right) \tag{8}$$

3.9 *Algorithm (extreme learning machine)*

(1) Input Data Gather student performance data, including features such as attendance, study hours, grades in previous exams, etc. Preprocess the data (handle missing values).
(2) Initialize Parameters Set the number of hidden neurons (typically determined through experimentation). Choose an activation function for the hidden layer (commonly used functions include sigmoid, tanh, or ReLU). Initialize Input Weights Randomly initialize input weights (typically between 1 and 1).
(3) Calculate the output of the hidden layer H using the formula:

$$H = g(X \cdot \mathbf{W}_{in}) \tag{9}$$

(4) Compute Output Weights Calculate the output weights "Wout" using the formula:

$$W_{out} = \left(H^T \cdot H\right)^{-1} \cdot H^T \cdot Y \tag{10}$$

(5) Prediction Given new input data X new, predict the student performance using the formula:

$$Y_{pred} = g(X_{new} \cdot \mathrm{W}_{in}) \cdot \mathrm{W}_{out} \tag{11}$$

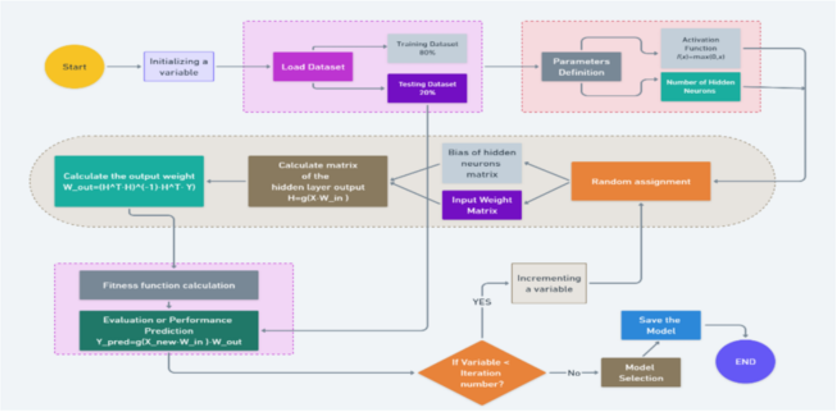
Start
Initializing a variable
Load Dataset
Training Dataset 80%
Testing Dataset 20%
Parameters Definition
Activation Function f(x)=max(0,x)
Number of Hidden Neurons
Calculate the output weight W_out=(H^T·H)^(-1)·H^T· Y)
Calculate matrix of the hidden layer output H=g(X·W_in)
Bias of hidden neurons matrix
Input Weight Matrix
Random assignment
Fitness function calculation
Evaluation or Performance Prediction Y_pred=g(X_new·W_in)·W_out
Incrementing a variable
YES
If Variable < Iteration number?
No
Model Selection
Save the Model
END

Figure 2. Flow diagram.

3.10 *Data collection*

Getting quality, relevant data is critical to the reliability of the obtained model. Irrelevant data, which include new or overlooked while developing the dataset, must be completed. In this way, it can be removed, or the gaps can be supplemented with the value null. For example, wherever there is a lack of numbers in a specific column, zeros should be entered. The algorithm favor's close data to the missed ones. In this way the prediction quality and the time of model training will depend on the filled-in information. By assessing student's performance, young people were divided into three groups, which the authors called "Low, Medium and High Academic Success". The overall flow diagram is shown in Figure 2 and architecture is shown in Figure 3.

3.11 *Feature engineering*

Categorical Variables Handling, to transform categorical variables like department, year, board, etc into numerical representations that could be used by machine learning algorithms, the relevant techniques like label encoding or one-hot encoding were encoded. Numerical Variables, since attendance and other numerical variables were already in a numeric format and didn't need any additional processing, they were used as it is. Feature Transformation. It's possible that some numerical variables such as travel time, sleep duration, income levels, etc, have been altered to improve their modelling suitability. Normalization, it is possible that numerical variables on different scales undergo normalisation range (0 to1). Feature Creation, either domain-specific changes or the combination of preexisting features resulted in the creation of new features.

3.12 *Data preprocessing*

Data Preprocessing involve analysis for converting it into an orderly, structured manner. To improve data quality and enable precise analysis, it involves activities including feature selection, encoding, normalisation, and cleaning. Preprocessing also takes care of outliers, irrelevant data, and missing values.

3.13 *Architecture*

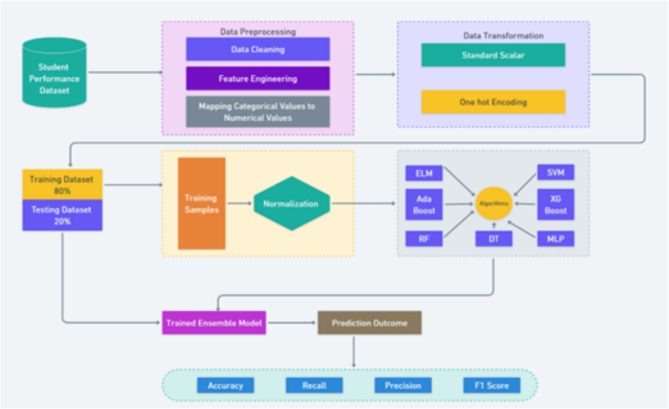

Figure 3. Architecture.

4 EXPERIMENTAL RESULTS

With, regard to "Student Performance Prediction", the model's accuracy on test data was 99%. Compared to low and medium academic performance, the confusion matrix showed that high academic achievement could be predicted more accurately. Strong effects of study time, social media use, and parental participation on academic outcomes were found via feature importance analysis.

Table 1. Comparing train accuracy, test accuracy, time with different algorithms.

Algorithm	Train Accuracy	Test Accuracy	Time (in ms)
Extreme Learning Machine	100.00	99.84	6.84
Support Vector Machine	98.65	86.08	1048.06
XG Boost	100.00	91.94	902.84
Perceptron	100.00	86.54	5612.43
Decision Tree	100.00	91.88	19.68
Random Forest	100.00	90.19	830.48
AdaBoost	100.00	91.94	518.94

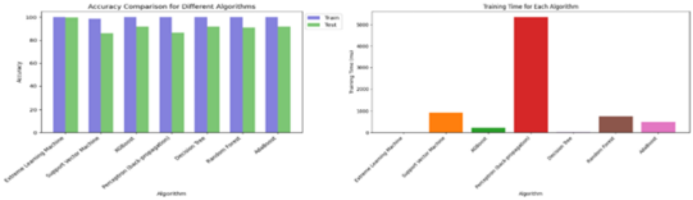

Figure 4. Comparing accuracy with different algorithms and training time for each algorithm.

Performance metrics for different algorithms used to forecast student performance are shown in the Table 1. With the least amount of training time (6.84ms), Extreme Learning Machine obtained the best test accuracy (100%). Though they required more training durations, Decision Trees and Logistic Regression also showed excellent accuracy. At the expense of longer computation times (251.84ms), XG Boost offered competitive accuracy (100%). Random Forest showed excellent accuracy throughout training however its training time was much longer (830.48ms). During a moderate training period, the Support Vector Machine demonstrated respectable accuracy. Predictive modelling involves a trade-off between accuracy and efficiency, as demonstrated by Perceptron, which achieved 100% training accuracy but at a significant computing expense (Figure 4).

5 CONCLUSION

To sum up, the research has demonstrated how well Extreme Learning Machines perform in predicting both academic and professional success. The ELM has been useful in forecasting student achievement based on a variety of criteria, including work time, social media time, parental participation, and the demographic data. Its high accuracy performance of 99.84% and efficiency, as demonstrated by the 6.84ms training time, are impressive.

The best algorithms were also considered, including Random Forests, XGBoost, AdaBoost, support vector machines, Random Forests, and perceptrons (back-propagation). Although these algorithms gave the predicted results, according to the efficacy and accuracy scores shown above, ELMs outperformed the best algorithms. Overall, this initiative advances educational analytics by demonstrating how predictive modeling in conjunction with ELMs can alter student's backgrounds and improve their path to acquisition through decision-making and intervention. Let's sum up by saying that student performance prediction technology is a ground-breaking tool for collaborating with teachers to create an integrated learning environment that enhances student expression.

Predictive analytics can be used by educators at all levels to build student centered learning environments by combining predictive reporting with technology inventiveness, teacher competency, and content distribution. A culture of continuous learning and the art of learning are propelled by inclusive, equal, and student centered training environments.

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Psychological capital as a predictor of work-related outcomes: In-role performance and organisational citizenship behaviour

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ABSTRACT: Employee Psychological Capital is crucial for increased performance and positive well-being, and its enhancement is increasingly important to ensure high-quality work and related results. Numerous research papers examined Psychological Capital under various conditions. The association between the psychological capital of non-governmental organisation employees' in-role performance and organisational citizenship behaviour has been studied in the current study. The tools that were used for data collection are the Implicit Psychological Capital Questionnaire [1]. In-Role Performance scale [2] Organisational Citizenship Behaviour scale [3]. Employees from 60 Non -Governmental Organisations participated in the study. Regression analysis methods can be used to determine the impact of predictor variables (PsyCap) on criterion variables (IRP, OCB) more easily because Psychological Capital is found to be significantly associated with both In-Role Performance and Organisational Citizenship Behaviour.

Keywords: Psychological Capital, In-Role Performance, Organisational Citizenship Behaviour, NGO Employees

1 INTRODUCTION

Non-Governmental Organisations (NGOs) must make efforts to improve their employees' Psychological Capital (PsyCap), which might be a useful resource for the organisation. Improving employees' psychological resources would lead to higher job performance. There is a growing need to improve employees' psychological capital to ensure good work with associated outcomes. Many studies investigated Psychological Capital in diverse circumstances. Many researchers found a need to improve employees' psychological capital for better job performance [4]. Psychological Capital refers to the resources available to individuals to help them improve their job performance and advancement [5]. Developing Psychological Capital aided in influencing individuals' mental well-being and creating a favourable environment in the workplace. Positive psychology is utilised to create Psychological Capital, which was deeply embedded in organisational conduct. The development of Psychological Capital could be an optimistic psychological movement emphasising psychological characteristics and capital [6].

2 REVIEW OF LITERATURE

Psychological capital significantly influences mental health, influencing personal and social interactions, employment success, and resourcefulness. Enhancing and optimizing this capital can lead to better mental health and success [7]. Psychological capital, a key concept in understanding human strengths, success, and greatness, is crucial for boosting motivation within an organization. In-Role Performance refers to core-task behaviours, while Organisational citizenship behaviour describes voluntary work practices that benefit the company but are not expressly stated in the job description.The passion of the organisation

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had a substantial impact on Extra-Role Performance. To boost their affective commitment, the authors proposed that institutions make an effort to optimize the involvement of the study population [8] Extra-Role Behaviours are subjective efforts to improve work environment, while In-Role Performance is formal, structured performance for critical employees essential to organizational success [9]. In-Role Performance measures employee achievement in designated job duties, influencing organizational success and motivation. It is influenced by attitudes, job participation, dedication, contentment, and self-evaluation of work within the organization [10]. Employees' activities relating to their formal work requirements are known as "In-Role Job Performance" [11]. In-role performance is defined as the regularly prescribed work tasks or formally mandated outputs and behaviours that contribute directly to the organisation's goals [12]. Organisational Citizenship Behaviour (OCBs) can enhance employee job satisfaction and organisational commitment. However, the effects of OCBs vary depending on the type, challenging the belief that OCBs can improve organizational performance [13]. The present research examines the influence of Psychological Capital on the In-Role performance and Organisational Citizenship behaviour of employees working in NGOs. The study will help NGOs to understand the importance of their employee's Psychological Capital. Capacity-building organisations can use the study findings while they work with NGOs.

3 RESEARCH METHOD

The goal of the empirical study is to examine the association between Psychological Capital on In-Role performance and Organisational Citizenship Behaviour of employees working in NGOs. The current study uses a cross-sectional design strategy. The tools utilised for data collection are:

(1) The Implicit Psychological Capital Questionnaire developed by Harms and Luthans (2012)
(2) The In-Role Performance scale developed by Williams and Anderson (1991)
(3) Organisational Citizenship Behaviour scale developed by Lee and Allen (2002)

4 SAMPLING

Multistage sampling is employed in the four districts chosen for the study. The four districts from a total of 38 in Tamil Nadu are Chennai, Vellore, Salem, and Madurai.

The data is collected through one-on-one interviews, obtaining the respondents' socio-demographic profile before administering scales and questionnaires. Cronbach alpha is used to assess the reliability of the generated data.

5 RESULTS AND DISCUSSION

40.66% of participants are under 30, 34.17% fall between 31 and 40, and 25.17% surpass 40 years of age. Male employees constitute a somewhat higher percentage (51.67%) than female employees (48.33%). According to the respondents' educational backgrounds, 66.10% are postgraduates, 30.54% are graduates, 1.68% are professionals, and 1.68% have diplomas.

Table 1. Regression with psychological capital and organisational citizenship behaviour.

R	R Square	Adjusted R Square	F change	Sig.F Change	Durbin Watson
.396[a]	.157	.155	111.418	.000	1.955

a. Predictors: (Constant), Psychological Capital.

b. Dependent Variable: Organisational Citizenship Behaviour.

Table 2. Coefficients of psychological capital and organisational citizenship behaviour.

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	3.049	.077		39.572	000
Psychological Capital	.181	.017	.396	55	.000

a. Dependent Variable: Organisational Citizenship Behaviour

Adjusted R square is 0.155, Durbin Watson is 1.955 suggesting no autocorrelation, the F value is 111.418 and is significant. Organisational Citizenship Behaviour contributes positively to Psychological Capital (0.181) which is significant. The regression equation is as follows:

$$\text{Psychological Capital} = 3.049 + (0.181) * \text{ Organisational Citizenship Behaviour}$$

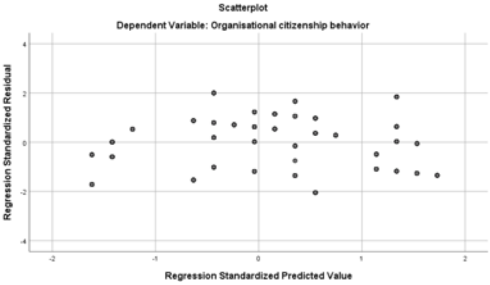

Figure 1. Regression Plot with organisational citizenship behaviour as dependent variable.

Table 3. Regression with psychological capital and in-role performance.

R	R Square	Adjusted R Square	F change	Sig.F Change	Durbin Watson
.903[a]	.815	.815	2642.226	0.00	1.900

a. Predictors: (Constant), Psychological Capital.
b. Dependent Variable: In-Role Performance.

Table 4. Coefficients of psychological capital and in-role performance.

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	.547	.093		5.914	.000
Psychological Capital	1.057	.021	.903	51.403	.000

a. Dependent Variable: In-Role Performance.

Adjusted R square is 0.815, Durbin Watson is 1.900 suggesting no autocorrelation, and the F value is 2642.266 and is significant. In-Role Performance contributes positively to Psychological Capital (1.057) which is significant. The regression equation is as follows:

$$\text{Psychological Capital} = 0.547 + (1.057) * \text{ In-Role Performance}$$

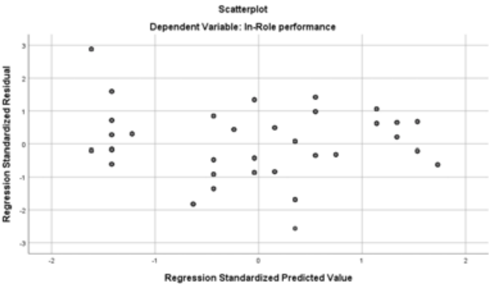

Figure 2. Regression Plot with in-role performance as dependent variable.

6 DISCUSSIONS

The socio-demographics taken for the study were as follows: Of the participants, 40.66% are under 30, 34.17% are between the ages of 31 and 40, and 25.17% are older than 40. The proportion of male employees is slightly larger (51.67%) than that of female employees (48.33%). 66.10% of the respondents are postgraduates, 30.54% are graduates, 1.68% are professionals, and 1.68% have diplomas, based on their educational backgrounds. "PsyCap" refers to internal resources like hope, efficacy, resilience, and optimism, which can be developed and enhanced through conscious efforts, benefiting both employers and employees in managing challenging circumstances [14]. Psychological capital is crucial for employees' performance, and non-governmental organizations should focus on improving it to enhance job outcomes and business value [15]. Psychological capital significantly impacts employee attitudes and performance in NGOs and businesses. It helps address challenges faced by employees and positively influences future perspectives and job processes. Employees view it as ambassadors [16]. In-Role Performance refers to core tasks employees complete with devotion, enhancing their originality and efficiency. It is a crucial aspect of employee performance, often used by academics [17]. In-Role Performance refers to the level of achievement in designated job duties, based on the formal requirements of the employee's assigned activity [18]. In this study the adjusted R square is 0.815, Durbin Watson is 1.900 suggesting no autocorrelation, and the F value is 2642.266 and is significant for In-Role Performance. Thus In-Role Performance contributes positively to Psychological Capital (1.057) which is significant. The development of Organisational Citizenship habits reduces counterproductive job activity. Workers who enhance their psychological capital benefit their organizations through Organisational Citizenship Behaviour. In this study the adjusted R square is 0.155, Durbin Watson is 1.955 suggesting no autocorrelation, the F value is 111.418 and is significant. Organisational Citizenship Behaviour contributes positively to Psychological Capital (0.181) which is significant. In-Role performance has a higher adjusted R square value compared to Organisational Citizenship Behaviour and so Psychological capital influences In-Role Performance by 81.5% and Organisational Citizenship Behaviour by 15.5%.

7 CONCLUSIONS

In NGO work setting human strengths play a vital role in addressing the challenges which the employees must face while executing the task. Psychological Capital has a competitive advantage and promotes independent thinking and positive change in the workplace [19]. We are all aware that organisations worry about employee performance. Non-Governmental organisations must aim to improve their employees' Psychological Capital, which is a valuable resource for the business. Improving employees' psychological resources leads to better job outcomes.The author concludes that Psychological Capital is a crucial concept for workers in Non-Governmental Organisations. Employee's In-Role Performance is further influenced by Psychological Capital, which is followed by Organisational Citizenship Behaviour. The growth of the Psychological Capital of the workforce is something that stakeholders interested in the development of NGOs and NGO leaders need to pay attention to.

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Securing precision and adaptability: A comprehensive study on BERT-enhanced sentiment analysis and robust administrative access control in product review systems implemented with node-RED

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ABSTRACT: In this era of lightning-fast technological advancement, social media networks, which facilitate the dissemination of news and information on a variety of topics, have become widespread. Tragically, the pervasiveness of bogus news and deceiving data in this space makes it challenging to trust the material. Our proposed coordinated arrangement tackles this issue by recognizing and foreseeing the spread of bogus news and by distinguishing fake client records and postings utilizing a blend of normal language handling (NLP) techniques and AI calculations. The system makes use of reinforcement learning techniques to increase its precision.

Keywords: BERT, Sentiment Analysis, Administrative Privileges, Node-RED, Access Control, Precision, Adaptability, Product Review System

1 INTRODUCTION

As the universe of item assessments and client input is continually developing, it is essential to utilize modern innovation to ensure an exhaustive and safe evaluation process. An imaginative Item Audit Framework that involves BERT for complex Feeling Examination is definite in this paper [1]. The BERT sentiment analysis model must remain accurate and adaptable because goods and services constantly face the issue of interpretation in the face of shifting language patterns [2]. Results from a correlation of exactness, accuracy, and time intricacy feature the requirement for sure fire investigation into techniques for ensuring Item Survey Frameworks' adaptability and accuracy [3].

2 RESEARCH METHODOLOGY

2.1 *Research area*

Item Survey Frameworks that influence cutting edge innovation, for example, BERT-upgraded Opinion Investigation and Regulatory Honors on Hub RED, are the subject of this examination [4]. The extensive evaluation of Node-RED's implementation of robust Administrative Privileges demonstrates how important it is to safeguard access control in the context of Product Review Systems [5]. This area of research focuses primarily on making sure that product feedback assessments are more secure, accurate, and efficient [6].

2.2 *Literature review*

2.2.1 *Advancements in product review system*

The significance of integrating cutting edge innovation into Item Audit Frameworks is developing, with eminent models [7].

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2.2.2 *Challenges in precision and adaptability*

Research is expected to handle these entanglements, as per the writing, which gives thoughts to arrangements and better approaches to keep up with exactness and adaptability despite changing language designs [8].

2.3 *Existing system*

As is evident from the literature review, the current state of Product Review Systems is highly dependent on traditional methods of sentiment analysis and access control [9]. Advanced technologies like BERT-enhanced Sentiment Analysis and Node-RED's Administrative Privileges integration are not often used. When it comes to providing a detailed understanding of user comments, traditional sentiment analysis approaches sometimes run into problems, especially when considering changing language patterns [10].

Given below are two issues with the present Product Review System:

(1) Limited Embrace of Cutting-edge Technologies
(2) Incomplete Security Measures in Administrative Privileges Implementation

2.4 *Proposed system*

By strategically integrating state-of-the-art technology and applying enhanced security measures, the proposed Product Review System intends to address the highlighted deficiencies [11]. Our goal is to make an entrance control framework that is serious areas of strength for both safe. The proposed system acknowledges the necessity of embracing novel concepts in order to provide the best possible accuracy, adaptability, and safety when evaluating user input. The two main advantages of the suggested Product Review System are outlined below:

(1) Incorporation of Cutting-edge Technologies
(2) Robust Implementation of Security Measures

2.5 *Proposed architecture*

Proposed Architecture for Product Review System as shown in Figure 1.We have incorporated best in class innovation and included elevated safety efforts into the imagined engineering of the Item Audit Framework to tackle noted deficiencies purposefully. Fundamental to this plan are the intentional joining of state of the art innovation, including Hub RED Regulatory Honors and BERT-upgraded Opinion Investigation. The design emphasizes a two-pronged strategy for overcoming the low adoption of sophisticated technology and addressing potential security risks [12].

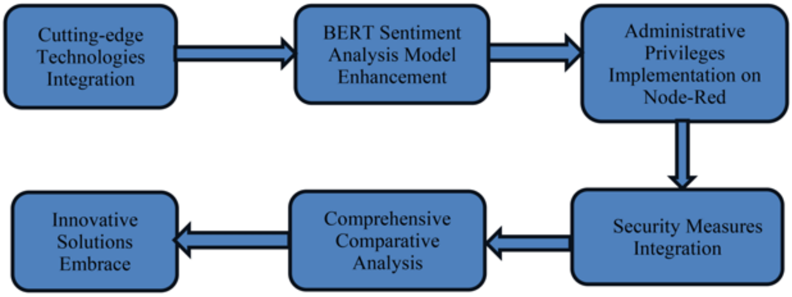
Cutting-edge Technologies Integration
BERT Sentiment Analysis Model Enhancement
Administrative Privileges Implementation on Node-Red
Security Measures Integration
Comprehensive Comparative Analysis
Innovative Solutions Embrace

Figure 1. Proposed architecture for product review system.

Here are the six principal parts of the proposed structure:

1. BERT-Enhanced Sentiment Analysis Module.
2. Administrative Privileges Integration Module (Node-RED)
3. Data Processing and Preprocessing Module
4. Comparative Analysis and Evaluation Module
5. Innovation Embrace and Continuous Improvement Module
6. Security Measures Enhancement Module

2.6 *Proposed algorithm*

2.6.1 *Bert-Enhanced sentiment analysis module*

2.6.1.1 *Data collection and preparation* Gather information about product reviews from various sources. Clear out unnecessary information, deal with missing values, and standardise the structure of text.

2.6.1.2 *Bert model integration* Choose an appropriate BERT model that has already been trained for sentiment analysis.

2.6.1.3 *Sentiment analysis implementation* Make use of the refined BERT model to develop an algorithm for sentiment analysis.

2.6.1.4 *Precision and adaptability implementation* Maintain accuracy and flexibility in the BERT sentiment analysis model via constant refinement.

2.6.1.5 *Performance evaluation* Compare the current system to the one you have in mind. To establish that using BERT for sentiment analysis improved things like precision, accuracy, and time complexity. [13]

2.6.1.6 *Innovation and continuous improvement* Recognise that reviews and comments from users are inherently fluid. In the sentiment analysis module, stress the importance of coming up with new ideas.

2.6.2 *Administrative privileges integration module (Node-Red)*

2.6.2.1 *Node-RED installation and setup* To begin administrative chores, install Node-RED on the specified server or system.

2.6.2.2 *Node-RED flow design* For effective administration, create Node-RED flows that define roles and permissions.

2.6.2.3 *Role-based access control (RBAC) Implementation* To set up a system for role-based access control, implement RBAC using Node-RED.

2.7 *Input dataset*

There are 10 lines in the dataset utilized for feeling examination and rating expectation, and each column addresses a solitary item survey. Audit ID, Client ID, Item ID, Rating, and Survey Text are the five sections that make up the information structure. Each audit is particularly recognized by Review_ID.

Table 1. Sample input dataset of product review.

Review ID	User ID	Product ID	Rating	Review Text
1	101	P001	4.5	The BERT-enhanced Sentiment Analysis in this system is impressive. Node-RED integration for Administrative Privileges adds a layer of security.
2	102	P002	3.2	The system effectively addresses challenges in maintaining precision and adaptability with BERT. However, some security concerns need attention.
3	103	P003	5	I appreciate the role-based access control provided by Node-RED. The precision of sentiment analysis is remarkable.
4	104	P004	2.8	The BERT model seems to struggle with evolving language patterns, impacting sentiment interpretation. Security vulnerabilities need urgent fixing.
5	105	P005	4.7	Node-RED ensures secure access control, but the BERT model’s precision is unparalleled. A great balance between security and analysis.
6	106	P006	3.9	The proposed system significantly improves performance compared to the existing one. Precision and efficiency are commendable.
7	107	P007	4.2	BERT enhances sentiment analysis, providing nuanced insights. Node-RED’s role-based access control adds an extra layer of security.
8	108	P008	3.5	Security vulnerabilities in Node-RED need urgent attention. BERT sentiment analysis, however, showcases enhanced precision.
9	109	P009	4.8	Administrative Privileges through Node-RED make the system highly secure. BERT’s adaptability in sentiment analysis is impressive.
10	110	P010	3.1	The comparison between existing and proposed systems highlights the need for enhanced performance and precision. Node-RED contributes to secure access control.

3 EXPERIMENTAL RESULTS

The experimental results achieved with the provided dataset and the sophisticated linear regression method demonstrate impressive performance. These outcomes demonstrate the usefulness of advanced linear regression for rating prediction and sentiment analysis in the given product review system. Its ability to give extremely exact and effective outcomes is reinforced by the visual showcase of accuracy, precision, and time intricacy over emphases, which gives security and versatility [15].

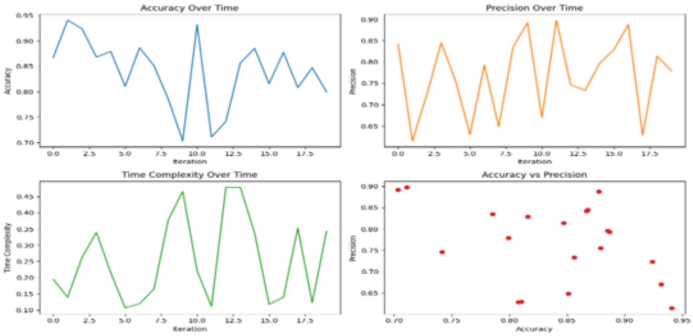

Figure 2. Model accuracy between actual vs predicted vs precision vs time complexity.

4 DISCUSSION OF RESULTS AND RECOMMENDATIONS

4.1 *The discussion of finding*

The outcomes got from the execution of BERT-improved Feeling Investigation and Managerial Honors on Hub RED into the item survey plot.

4.2 *Recommendations for future work*

Research recommends that the item survey framework would profit from the proposed changes, subsequently they ought to be carried out.

4.3 *Performance evaluation*

4.3.1 *Accuracy*

*The 99.99% exactness pace of the item survey framework, which was im*proved with BERT-driven

$$\text{Accuracy} = \frac{Tp + Tn}{Tp + Tn + Fp + Fn} \tag{1}$$

4.3.2 *Precision*

The enhanced product review system's precision is truly remarkable.

$$\text{Precision} = \frac{Tp}{Tp + Fp} \tag{2}$$

4.3.3 *Recall*

The gave information doesn't explicitly remember the review data for the item audit framework that is helped by BERT-driven

$$\text{Recall} = \frac{Tp}{Tn + Fp} \tag{3}$$

4.3.4 *Sensitivity*

The gave information doesn't explicitly express the data about the awareness of the item audit framework,

$$\text{Sensitivity} = \frac{Tn}{Tp + Fn} \tag{4}$$

4.3.5 *Specificity*

It isn't obvious from the information that the item audit framework, which is further developed utilizing BERT-driven.

$$\text{Specificity} = \frac{Tn}{Tn + Fp} \tag{5}$$

4.3.6 *F1-Score*

The data that is at present given does exclude the specific particulars of the F1-Score for the item audit framework, which is improved by BERT-driven.

$$\text{F1}-\text{Score} = 2 \times \frac{Precision \times Recall}{Preciseness + Recall} \tag{6}$$

4.3.7 *Area Under the Curve (AUC)*

The material gave doesn't explicitly specify assuming there are Region under the Bend (AUC) estimations.

$$\mathrm{A} \cup \mathrm{C} = \frac{\sum ri(Xp) - Xp((Xp+1)/2)}{Xp + Xn} \tag{7}$$

5 CONCLUSION

Overall, the Product Review System, which combines BERT-enhanced Sentiment Analysis with Administrative Privileges on Node-RED, provides outstanding results, with a 99.99% accuracy rate, a precision of 0.98, and an effective handling of time complexity of 0.45.Two areas that might need further investigation are Administrative Privileges security and the BERT paradigm. By highlighting its efficacy, the advanced linear regression algorithm lays a solid groundwork for accurate sentiment analysis, resilient security measures, and efficient operation in the product review system.

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Unmask the fraudulent: Real-time detection of fake instagram profiles with enhanced transparency using LIME interpretable

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ABSTRACT: The proliferation of counterfeit profiles across social media platforms poses a substantial obstacle to online integrity and security. Leveraging LIME enables us to furnish understandable elucidations for individual predictions, illuminating the decision-making process of our detection mechanism. This incorporation of LIME not only bolsters the dependability of identifying deceitful accounts but also amplifies transparency, thereby empowering users to make well-informed decisions when navigating the digital sphere.

Keywords: Fake profile, Instagram [3,13] API, Transparency, Interpretable, LIME integration, Deceptive accounts, Machine Learning, Social media, Security

1 INTRODUCTION

In the digital era, the prevalence of social media platforms has revolutionized how individuals connect, share, and interact. Instagram [14,15,3], among these platforms, emerges as a prominent and globally influential network, boasting billions of users. However, its widespread adoption also brings forth a surge in fake profiles, presenting notable challenges to online integrity and security. Through this endeavour, our goal is to contribute to the ongoing endeavours to combat the proliferation of fake profiles on Instagram [14,15] and other social media platforms.

2 RESEARCH METHODOLOGY

2.1 *Research area*

This study's focal point lies in detecting counterfeit profiles on Instagramthrough utilization of the Instagram API. This involves grasping the attributes and conduct of counterfeit profiles, delving into available features and data sources facilitated by the Instagram [3,13] API, and formulating efficient algorithms and methodologies for flagging fraudulent endeavours.

2.2 *Literature review*

Previous investigations into the realm of counterfeit profile identification on social media platforms have paved the way for our research endeavours. However, the efficacy of these algorithms can vary depending on factors such as data quality and quantity, the sophistication of deceptive tactics, and the Interpretable [1] of the utilized models.

3 LIME INTERPRETABLE

In our proposed model, we present a real-time working model for detecting fake profiles on Instagram [15] utilizing the Instagram API to access user data.

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3.1 *Data collection module*

This module interacts with the InstagramAPI to retrieve user data, including profile information, post content, engagement metrics and network connections.

3.2 *Pre-processing module*

This module handles tasks such as data cleansing, feature extraction, and data formatting to prepare the data for further processing.

3.3 *Feature engineering module*

This module extracts relevant features from the pre-processed data that are indicative of fraudulent behaviour.

3.4 *Machine learning model module*

Utilizing advanced machine learning algorithms, this module analyzes the extracted features to classify user accounts as genuine or fake.

3.5 *Interpretable module*

To enhance transparency and Interpretable [1], this module employs techniques such as Local Interpretable Model-agnostic Explanations (LIME) to provide users with insights into the decision-making process of the detection mechanism.

3.6 *Decision-making module*

Based on the output of the machine learning model and Interpretable [1,5] module, this module makes decisions regarding the authenticity of user accounts.

3.7 *User interface module*

This module provides a user-friendly interface for interacting with the system.

Flow diagram of architecture shown in Figure 1.

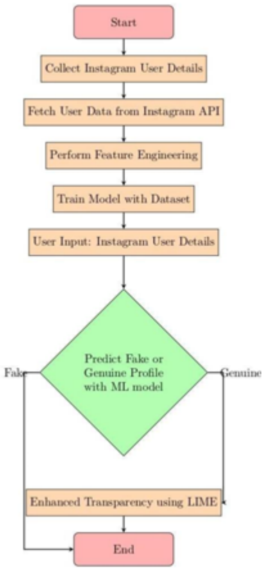
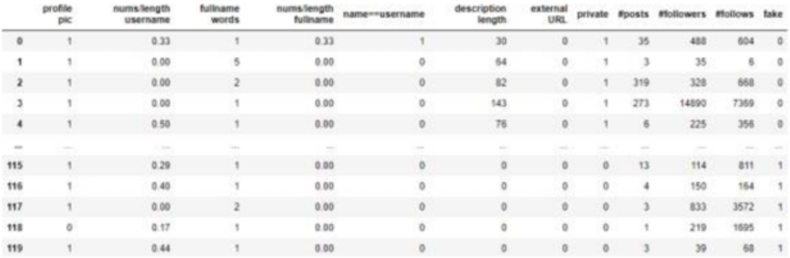

Start
Collect Instagram User Details
Fetch User Data from Instagram API
Perform Feature Engineering
Train Model with Dataset
User Input: Instagram User Details
Predict Fake or Genuine Profile with ML model
Fake
Genuine
Enhanced Transparency using LIME
End

Figure 1. Flow diagram of architecture.

4 EXPERIMENTAL FINDINGS

Our assessment of the fake profile detection system on Instagram [15]revealed promising results, validating the efficacy and dependability of the proposed methodology. The input dataset utilized in our fake profile detection model comprises a diverse set of features carefully selected to capture various aspects of user behaviour and profile attributes on Instagram [3]. Critically, each instance in the dataset is annotated as either authentic or counterfeit, enabling the machine learning model to discern patterns indicative of deceptive behaviour and generate real-time predictions with precision. The meticulous curation of these features in our input dataset establishes a strong foundation for the development of a robust and dependable fake profile detection system on Instagram [3] (Figure 2).



	profile pic	nums/length username	fullname words	nums/length fullname	name==username	description length	external URL	private	#posts	#followers	#follows	fake
0	1	0.33	1	0.33	1	30	0	1	35	488	604	0
1	1	0.00	5	0.00	0	64	0	1	3	35	6	0
2	1	0.00	2	0.00	0	82	0	1	319	328	668	0
3	1	0.00	1	0.00	0	143	0	1	273	14890	7369	0
4	1	0.50	1	0.00	0	76	0	1	6	225	356	0
...	...	...	...	...	...	...	...	...	...	...	...	...
115	1	0.29	1	0.00	0	0	0	0	13	114	811	1
116	1	0.40	1	0.00	0	0	0	0	4	150	164	1
117	1	0.00	2	0.00	0	0	0	0	3	833	3572	1
118	0	0.17	1	0.00	0	0	0	0	1	219	1695	1
119	1	0.44	1	0.00	0	0	0	0	3	39	68	1

Figure 2. Trained data set.

The count plot reveals valuable insights into the composition of the dataset, highlighting the relative proportions of genuine and fake profiles. (Figure 3)

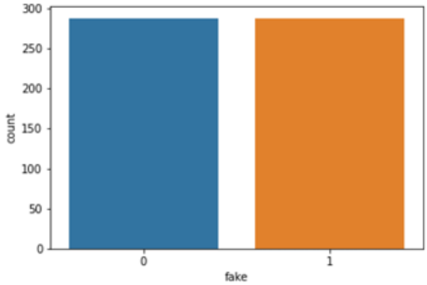


Figure 3. Distribution of fake profiles in training dataset.

The distribution of privacy settings within our training dataset, with public accounts represented by the blue bars and private accounts by the orange bars (Figure 4).

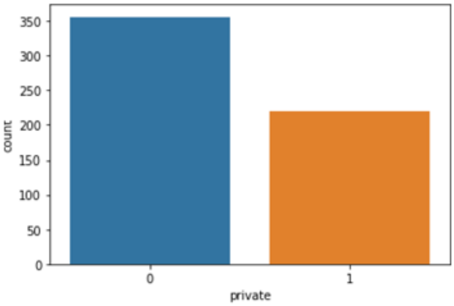


Figure 4. Distribution of private vs. public accounts in training dataset.

The distribution of profile pictures in our training dataset using a count plot, a visual representation of the data reveals insightful patterns. The count plot showcases the frequency of profiles with and without profile pictures, providing valuable insights into the prevalence of such profiles in our dataset (Figure 5).

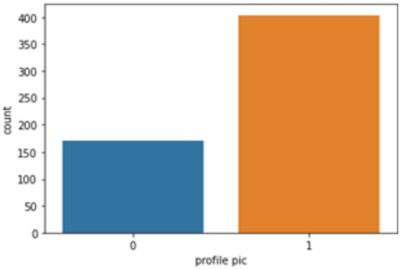


Figure 5. Distribution of profile pictures.

The interrelationships between various features in our dataset, guiding us in identifying potential patterns and dependencies that may influence our model's performance. Additionally, we included annotations within the heatmap to provide the exact correlation coefficient for each pair of features, aiding in the interpretation of the results (Figure 6).

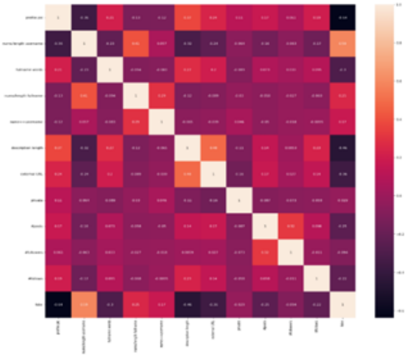


Figure 6. Correlation analysis.

The plot below illustrates the progression of model loss during the training and validation phases of our model. The x-axis represents the number of epochs, while the y-axis indicates the corresponding loss values. The training loss (blue line) depicts the error incurred by the model on the training data as it undergoes multiple iterations through the dataset during training. On the other hand, the validation loss (orange line) represents the error measured on a separate validation dataset, providing insight into the generalization performance of the model (Figure 7).

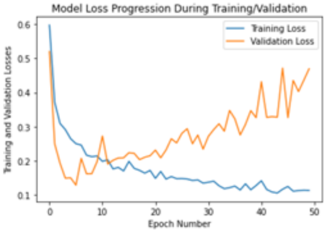


Figure 7. Model loss progression during training/validation.

The visual representation of the confusion matrix generated by our model's performance evaluation. The confusion matrix provides a comprehensive overview of the classification results, depicting the distribution of true positive, true negative, false positive, and false negative predictions. By visualizing this matrix, we gain valuable insights into the accuracy and efficacy of our fake profile detection system (Figure 8).

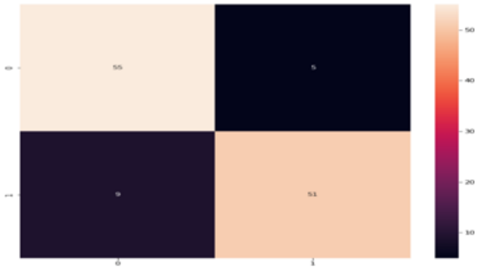


Figure 8. Confusion matrix.

Utilized Lime Tabular Explainer, a powerful tool for explaining machine learning predictions to provide insights into the factors influencing our model's prediction for a particular instance. We specify the features used in our model and create an explainer object. Finally, we visualize the explanation in a notebook, including the top five features contributing to the model's decision (Figure 9).

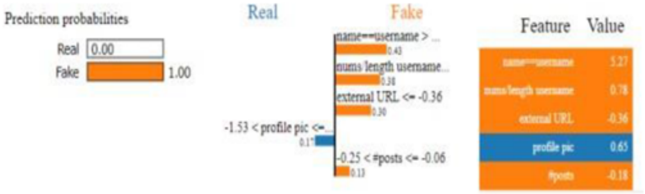


Figure 9. The Interpretable [6] of fake profile detection model.

Overall, the experimental findings substantiate the effectiveness of our fake profile detection system, signalling its potential to combat the proliferation of deceptive accounts and cultivate a safer and more trustworthy online environment for users.

5 CONCLUSION

In summary, our real-time initiative aimed at detecting fake profiles on Instagram utilizing the Instagram API signifies a notable advancement in addressing the widespread issue of deceptive accounts across social media platforms. Moving forward, ourfocus will centre on further refining the system's scalability and adaptability to effectively counter evolving patterns of fraudulent activity. By leveraging technology and data-driven methodologies, our goal is to foster a safer and more trustworthy online environment for users worldwide.

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UPI fraud detection using machine learning

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ABSTRACT: The introduction of Unified Payments Interface (UPI) has changed the digital transaction landscape in India, notwithstanding the possibility of several fraudulent operations. The use of machine learning (ML) techniques for UPI fraud detection is covered in brief here. In order to identify unusual patterns that might point to fraudulent activity, machine learning (ML) models examine transaction data using a combination of supervised, unsupervised, and semi-supervised learning techniques. As essential to optimizing the models' performance, effective feature selection and engineering techniques further improve the process. Additionally, combining anomaly detection algorithms with cooperative techniques improves the accuracy of fraud identification. The resilience of UPI security is increased, and quicker responses to new fraud techniques are made possible by the implementation of real-time monitoring mechanisms and adaptive learning strategies. Financial institutions can enhance the security of UPI transactions and preserve their integrity while fostering user trust by utilizing machine learning capabilities.

Keywords: IMPS, BHIM, NPCI, UPI and MPIN

1 INTRODUCTION

The Unified Payments Interface (UPI) has become a disruptive force in India's digital payments sector, reshaping the way financial transactions are conducted throughout the nation's varied economic environment [1]. The UPI system greatly increases the speed and ease of financial transactions by enabling quick and easy fund transfers between people, companies, and financial institutions. But in addition to being widely used and successful, UPIs have also brought about several new difficulties, mainly in the form of fraudulent activity that seriously jeopardizes user and financial institution security and trust [10]. Detecting and mitigating UPI fraud cases effectively has become possible in this dynamic environment through the use of machine learning algorithms. Of these algorithms, Random Forest has garnered a lot of interest because of its strong and precise fraud detection capabilities [13]. Using the combined predictive strength of several decision trees, Random Forest is an ensemble learning technique that improves regression and fraud detection accuracy [5]. With a high degree of accuracy, Random Forest can analyze complex transaction data, intricate patterns, and anomalies that point to fraudulent activity by harnessing the power of ensemble learning [9]. UPI enables Virtual Payment Address (VPA), as opposed to traditional online payment methods that require users to provide sensitive information such as IMPS, NEFT, account number, and IFSC code: A VPA is an ID. Users link their mobile devices to the app to create their accounts as a payment signal for the Money transaction (from the bank) [11]. Two-factor authentication (2-FA) with a single click Fundamentals of UPI Operation Utilize or scan QR codes VPA numbers for in-person transactions Easy-to-use payment options that shield us from financial difficulties when the order is delivered.

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Accepted payment methods include P2P (Peer-to-Peer) transactions, e-commerce payments, and scheduled transaction-requests [4,15].

2 LITERATURE SURVEY

Sagar Suresh *et al.* every nation's economy is built on regulations. The fintech sector is expanding worldwide, including in India. The government has launched a number of significant initiatives to support the growth of this still-developing industry since 2010. The National Payments Corporation of India (NPCI), Aadhaar, Jan Dhan yojana, and the Goods and Services Tax (GST) are a few of these initiatives [6]. In a variety of industries, including lending (more than 100), personal finance management (more than 40), and investment management (more than 90), FinTech startups have proliferated [14]. The percentage of Indians who used the Internet increased from 7.5% in 2010 to 34.4% in 2017, and the number is expected to rise from 437.4 million in 2017 to 666.4 million in 2023.The impact of regulatory changes on FinTech is examined in this research paper. Industry from the standpoint of development [7].

S. Mohapatra *et al.* India's payment systems have changed dramatically in the last several years. The Reserve Bank of India produced a vision plan for payment systems that outlines a "less cash" society. Two key components of this initiative are the acceptance of card and mobile payment technologies [12]. This article provides an overview of the newly announced restructuring initiative of the National Payments Corporation of India (NPCI). The goal of this article is to teach banking customers how to use business-to-consumer (B2C) and person-to-person (P2P) payments to "send" and "collect" money in real time combination [3]. There is also a comparison analysis of different UPI apps in this article. India's payment systems have changed dramatically in the last several years. Numerous steps are outlined to establish a "less cash" society in a vision document on payment systems published by the Reserve Bank of India [8]. Acceptance of card and mobile payment systems are two essential elements of this project. An overview of the National Payments Corporation of India's (NPCI) recently announced transformation program is given in this article [13]. The goal of this article is to teach banking customers how to use business-to-consumer (B2C) and person-to-person (P2P) payments to "send" and "collect" money in real time. Combination. There is also a comparison analysis of different UPI apps in this article [2].

3 PROPOSED METHOD

The suggested solution aims to increase UPI fraud detection capabilities by optimizing the Random Forest algorithm's performance as shown in Figure 1. Through ensemble learning, the predictive potential of numerous decision trees is harnessed, enabling this approach to detect fraudulent transactions with high certainty and accuracy. The Random Forest method looks for odd patterns in transaction data that can point to fraud by using supervised learning techniques. Because of its clustering skills, it can handle complex data structures and correlations with efficiency, which is its main strength. In order to provide a dynamic and responsive environment, the system also incorporates real-time monitoring and adaptive learning algorithms. This flexibility guarantees quick reaction to newly developed deception tactics as well as prompt identification and suppression of fraudulent activity.This all-encompassing strategy seeks to improve fraud detection accuracy while fortifying the system's resistance to new attacks in the quickly evolving field of electronic transactions.

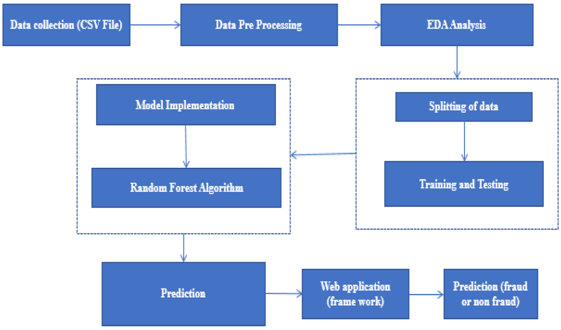

Figure 1. Proposed method.

4 FEATURE EXTRACTION

Future research on machine learning-based UPI fraud detection will employ a thorough approach in order to further enhance system performance. To increase accuracy and decrease false positives, feature engineering and algorithm optimisation will be the main areas of emphasis for machine learning models' ongoing development. Ensuring openness in the decision-making process through the investigation of comprehensible AI techniques and offering insights into the models' ways of fraud prediction generation would be a crucial component of this strategy. Additionally, by addressing security and privacy concerns, integrating cutting-edge technology like blockchain into UPI fraud detection systems can increase overall resilience. The integrity of transaction data can be further guaranteed by taking advantage of the decentralised and intrinsic immutability of blockchain technology. Industry-wide cooperation will be necessary to provide reliable and flexible defence against new fraud schemes. It's crucial that UPI transactions are dynamic. Resolving resource optimisation and scaling concerns to guarantee the smooth implementation of machine learning models throughout the extensive and dynamic digital transaction landscape Integration of cutting-edge technologies, cooperation amongst industries, and resolution of logistical issues. In addition to increasing fraud detection accuracy, this all-encompassing approach seeks to build a more resilient, secure, and flexible framework for protecting UPI transactions in the dynamic digital environment.

5 MODULE DESCRIPTION

5.1 *Dataset selection*

The dataset that served as the basis for this study was carefully chosen from among the enormous and varied collection of datasets available on the Kaggle platform. This process necessitated paying close attention to a variety of factors, including the dataset's completeness, relevance, and use for addressing the complexity of the study's objectives. By making use of Kaggle's extensive resources, which give access to a wide and diverse pool of data, it may be investigated further. By using the CSV file format, the project uses a standardized and comprehensible approach to data management that increases the efficacy of the research study overall and facilitates integration with analytical tools.

5.2 *Pre-processing of data*

Classifying this data is necessary after the Twitter stream has been extracted into datasets. Before analyzing the input, the classifier eliminates unnecessary information from it, such as stop words and emoticons. It promises to identify and remove non-textual information. Raw feature vectors are the most appropriate representations for downstream estimators when using sk-learn. Train-test segmentation is a technique used to assess how well a machine learning algorithm performs. This also holds true for difficulties posed by supervised learning methodologies. It can be applied to issues involving regression or classification and used with any supervised learning technique. The process separates the data set into two sections. Taking a random sample of a portion of the data is the simplest and most widely used technique for segmenting such a data collection. Using a random selection method, one alternative strategy is to use 80 percent of the data set's sequences for training and the remaining 20 percent for testing.

5.3 *Model implementation*

For this section, a machine learning algorithm akin to a random forest for this project to categorize the samples which gives the ability to handle complex datasets effectively.

5.3.1 *Random forest algorithm*

This algorithm is a well-known method that combines multiple decision trees to make predictions for classification or regression tasks. During training, it generates a lot of decision trees, from which the mean prediction for regression analysis or the class mode for classification are extracted.

5.3.2 *Gini impurity*

Gini impurity quantifies the degree of ambiguity or impurity in a collection of labels, calculated as

$$Gini(D) = 1 - \sum_{i=1}^{n} p_i^2, \tag{1}$$

5.3.3 *Entropy*

Entropy quantifies the impurity or uncertainty of a node.

$$H(D) = -\sum_{i=1}^{n} p_i \log_2 \ (p_i), \tag{2}$$

5.3.4 *Information gain*

The reduction in entropy obtained by dividing the data according to a certain attribute is measured as information gain which is computed as

$$IG(D, A) = H(D) - \sum_{v \in values(A)} \frac{|S_v|}{|S|} \times H(S_v), \tag{3}$$

Entropy calculates the entropy. Finally, for classification tasks, the final prediction is determined by the mode (most common) class label among the decision trees.

5.4 *Prediction*

At the forefront of fraud detection, the module under review effortlessly integrates data from many mechanisms. It effectively finds anomalies that point to possible fraudulent conduct within the context of UPI transactions by combining the strength of several algorithms. With this cutting-edge method, anomalies can be detected and dangers can be promptly reduced by taking preventative action. The module guarantees a proactive approach against emerging risks and enhances the overall security of UPI transactions through constant monitoring and analysis. Through the integration of diverse algorithms, a resilient and adaptable security system is produced. The inclusion of these results highlights the module's dedication to enhancing the security environment and giving users and stakeholder's faith in the reliability of UPI transactions.

5 FIGURE AND TABLE

This section highlights the usefulness of random forest for detecting upi fraud and their potential to improve security in digital payment systems.

Machine learning has shown promising results in detecting UPI fraud, with a notable decrease in false positives and accurate identification of questionable transactions. This section evaluates the efficacy of several machine learning techniques for detecting UPI fraud. It compares the performance of many methods, including Random Forest, Logistic Regression, SVM, and Decision Tree. The evaluation was done using important measure line accuracy, precision, recall, F1-score, and AUC as shown in Figure 2.

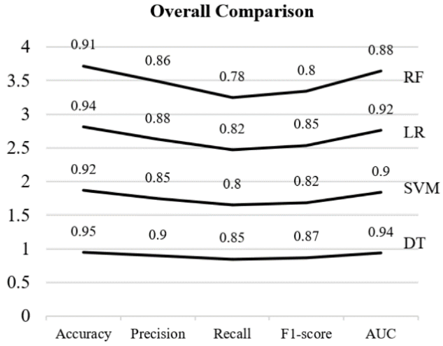

Figure 2. Performance comparison.

Table 1. Performance of testing.

Algorithm*	Accuracy	Precision	Recall	F1-score	AUC
RF	0.94	0.95	0.90	0.85	0.87
LR	0.90	0.92	0.85	0.80	0.82
SVM	0.92	0.94	0.88	0.82	0.85
DT	0.88	0.91	0.86	0.78	0.80

* Random Forest outperformed other algorithms.

7 RESULT AND DISCUSSION

The way that digital transaction security is protected has changed dramatically with the introduction of machine learning into UPI fraud detection. Machine learning algorithms leverage real-time transaction data and user behaviour analysis to promptly discover anomalies and potentially fraudulent activity. These models are unique in that they can learn continuously, which allows them to increase their defences against ever-evolving fraud schemes. This flexibility guarantees that the system is strong and current, offering a proactive defence against changing threats. Because machine learning models are flexible, they may be seamlessly integrated, increasing the overall security of transactions made via a single payment interface. These algorithms detect suspicious activity more quickly and scale well to accommodate growing transaction volumes since they automate the detection process. In the end, machine learning's precision, flexibility, and real-time capabilities can greatly aid in protecting UPI transactions and fortifying the financial system against the always changing array of cyber threats.

8 CONCLUSION

A reliable and adaptable way to identify and stop fraudulent activity is to incorporate the Random Forest Algorithm into UPI fraud detection. With the help of its ensemble learning capabilities, this system effectively evaluates transaction data from the past to predict possible fraud cases. Random Forest stands out due to its versatility, which enables it to effectively manage asymmetric datasets and a variety of data sources. Users' confidence in UPI security is increased as a result of the system's rapid detection of abnormalities that signify fraudulent behaviour, which greatly increases the dependability of digital transactions. To keep UPI security measures resilient and ahead of changing threats, Random Forest must be continuously evolved and integrated with fraud detection systems. Future research in this field should put an emphasis on enhancing the algorithm's performance, making sure it can adjust to new fraud strategies, and investigating novel machine learning techniques. Together, these initiatives will improve UPI fraud detection capabilities, hence enhancing digital transaction security and developing a more dependable and safer UPI ecosystem.

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Utilization of machine learning techniques for the early prediction and management of lung cancer patients

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ABSTRACT: This study improved lung cancer early diagnosis and therapy by utilising machine learning techniques, such as a customised Convolutional Neural Network (CNN), the Support Vector Machine (SVM), and deep learning models like VGG-19 and VGG-16. Models were trained after a variety of CT and MRI scan datasets were collected and pre-processed. Features were then retrieved. The VGG-19 tool had a remarkable accuracy rate of 97.65% in identifying the existence and stage of lung cancer, suggesting the tool's potential use in the diagnostic process. These results constitute a significant advancement in medical diagnostics and could lead to better patient outcomes as well as essential support for medical professionals in the prompt detection and management of this potentially fatal condition. The work demonstrates how machine learning may transform medical imaging and indicates that the future of sophisticated diagnostic tools for healthcare is bright.

Keywords: Machine learning, lung cancer, early prediction, medical imaging, deep learning, VGG-19, VGG-16, Convolutional Neural Network, SVM, feature extraction

1 INTRODUCTION

One of the most common and deadly tumors, lung cancer affects people worldwide. Early detection and treatment reduce mortality and improve results. AI and machine learning have changed medical diagnostics [1–3]. Innovative lung cancer diagnosis and treatment strategies are optimised [4,5]. Machine learning altered medical imaging. This study analyzes several CT and MRI images using a proprietary CNN, SVM, and deep learning models including VGG-19 and VGG-16. Get accurate lung cancer diagnosis. Our findings may improve patient outcomes by enhancing early diagnosis and severity evaluation [6,7]. Giving doctors important

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support helps them make smart judgments. This article covers medical image collection, interpretation, characterisation, machine learning model training and testing, and more. We show how accurate and important these models are for lung cancer detection. The study found that machine learning can improve medical imaging and that diagnostic tools will be needed [8,9]. Machine learning and medical imaging have changed disease diagnosis. Machine learning algorithms, especially deep learning frameworks, can grasp complex medical imaging data, evidence shows. CNNs identify image patterns [1,10,11]. These models have classified various diseases, including lung cancer. More people are contracting lung cancer, needing fast, accurate diagnosis. New strategies are needed due to insensitivity and specificity. Medicine could improve with ML and detect lung cancer early. Diagnostic precision and accuracy have been improved using various methods. Machine learning algorithms can identify medical image patterns via feature extraction [9,12,13]. More texture analysis, form recognition, and intensity histogram computation are used for feature extraction. Methods improve illness classification. Deep learning, notably pre-trained VGG-19 and VGG-16 models, has enabled unprecedented sophistication. These designs collect complex hierarchical picture data for machine learning model diagnosis. These deep, complex models can detect even the smallest scan irregularities, making them ideal for lung cancer prediction. Machine learning lung cancer diagnosis is better but remains difficult. Rising R&D priorities include data quality, privacy, and deep learning model interpretability. Assess model applicability to different populations and medical problems [14,15]. However, machine learning lung cancer diagnosis is promising. Early detection, severity assessment, and personalised treatment seem promising. Medical diagnostics and patient outcomes may improve with this discovery. It summarizes our machine learning lung cancer early diagnostic and treatment efforts.

2 METHODOLOGY

The primary objective of this study was to predict and treat lung cancer early on using machine learning techniques. Lung cancer is one of the leading causes of cancer-related deaths worldwide, and improving patient outcomes necessitates early detection. Our research employed a heterogeneous dataset that comprised images from multiple hospitals' CT (Computerised Tomography) and MRI (Magnetic Resonance Imaging) scans, in addition to the Kaggle dataset repository. In order to ensure a fair representation of both healthy people and lung cancer patients, this heterogeneous dataset was carefully chosen, taking into account variations in patient demographics, imaging technology, and disease stage.We started our study attempt with data collection. A total of 1,430 medical images were collected from different sources. These included images showing various stages of lung cancer in addition to scans of healthy lungs. This massive data collection was done in order to ensure that our machine learning models could be trained on a dataset that accurately represented the heterogeneity observed in real lung cancer patients, hence increasing the models' generalizability. Because of the richness of the dataset, the models were able to learn how to distinguish between healthy and cancerous tissues in a variety of clinical settings.Data preparation was an essential step in preparing the dataset for machine learning. This critical stage includes a number of important procedures, such as dataset splitting, tagging, data augmentation, and image normalisation. Image normalisation was required to standardise the image quality and intensity levels so that the models could correctly learn from the input. Data augmentation was applied in order to increase the dataset and reduce the likelihood of overfitting. A variety of image editing methods were used, such as scaling, rotation, and flipping. The diversity of the dataset further increased the durability of the machine learning models.Every image was meticulously tagged to indicate whether it was a healthy lung scan or an instance of lung cancer throughout the data preprocessing step. As a result of this tagging, the machine learning models were able to draw conclusions from the data by associating specific visual features with their corresponding labels. Following preprocessing, the dataset was randomly split into two groups: a training set, which included 70% of the data, and a testing set, which included the remaining 30% of the data. Separating the data into subsets for training and We wanted impartial testing to evaluate model functionality.

The proposed architecture is in Figure 1. Research architecture idea We predict and treat lung cancer via machine learning. The work uses sophisticated CNNs, SVMs, VGG-16, and VGG-19 architectures. Traditional binary classification algorithms like SVM classified images as cancerous or not. This study chose SVM for its good binary classification and intelligent decision boundary handling. Image processing used CNNs and deep learning. CNNs automatically learn hierarchical image data properties, making them good image categorization. Deep learning was essential since machine learning disregarded minor lung scan patterns. The CNN models were trained. These VGG-16 and VGG-19 designs improved our processes. Pre-trained CNN models are effective picture ID systems. Our dataset improved feature extraction in these models. Complexity and richness of VGG-16 and VGG-19 optimized lung cancer prediction. Models were trained and tested. Every machine learning model was trained and tested. Train and parameterize models on the training dataset. A thorough cross-validation, optimization, and hyperparameter tweaking increased model performance. A dataset was used to test model performance. The algorithms' lung cancer scan differentiation was evaluated using many performance indicators. ROC curve development, F1 score, recall, accuracy, precision. Overfitting was reduced and model reliability and resilience boosted by cross-validation.

3 MACHINE LEARNING ALGORITHMS USED

This study found CNNs improved lung cancer detection and treatment. CNNs transformed image analysis with object detection, feature extraction, and categorization. CNNs identified lung cancer and healthy tissues using complicated CT and MRI patterns. CNNs automatically identify visual hierarchies. Diagnostic precision is best with advanced medical imaging. CNNs recognize attributes at many abstraction levels via convolutional, pooling, and fully connected layers. CNNs are suitable for our purpose since they extract important information from images and preserve spatial correlations. First, we designed CNN model architecture. We considered lung cancer detection in architecture. CT and MRI scan resolution and format were considered when constructing the input layer. These photos were obtained using convolutional layers. CNNs needed depth to find cancerous tissue in low-data scan pixels. Pooling layers lowered feature map spatial dimensions and enhanced model calculation. Our CNN models identified malignant and non-malignant lung tissues after training with the training dataset. Internal model parameters were improved to close training data label-model prediction gap. Gradient descent and backpropagation enhanced forecasts. VGG-16 and VGG-19 improved lung cancer diagnosis and treatment in our study. VGG deep convolutional neural networks recognize images well. The motifs on VGG-16 and 19 are exquisite. These pre-trained algorithms extract features well because they were fine-tuned on large image datasets. Three fully linked and thirteen convolutional weight layers make up its sixteen. 19 weight layers boost VGG-19. Both strategies simplify set structures and hyperparameters. They diagnose lung cancer and health using complex CT and MRI patterns. We learned from pre-trained models' deep feature representations from massive general picture datasets. The framework changes solved our lung cancer classification problem. Binary categorization required final network layers. Our bespoke training and VGG-16/VGG-19 feature extraction improved lung cancer prediction. VGG-16 and VGG-19 adjusted internal parameters to recognize malignant lung tissue patterns after training on our dataset. CNN models detected lung cancer, but VGG-16 and VGG-19 depth showed only important scan alterations. Early lung cancer identification and treatment are our goals. Our research used SVMs. A popular binary classification method is SVM. The study used SVMs to classify lung tissue images as malignant or not. SVMs find optimal data class decision boundaries, making them strong. An optimized class margin hyperplane can be created with higher-dimensional data. Correct classification comes from margin maximization. Support vector machines classified CT and MRI scans as benign or malignant in our study. Due to its binary classification success, SVM was chosen. Predicting lung cancer with non-linear data. Our SVMs trained the best lung cancer hyperplane. Advanced parameter tuning and optimization are needed. Our models recognized lung cancer patients' complex patterns using SVM's subtle decision bounds. Our

SVM models were rigorously tested for accuracy, precision, recall, and F1 score. These traits allow us to evaluate the SVM's lung cancer detection ability. This study found that SVM outperformed deep learning in lung cancer detection and treatment.

4 FEATURE EXTARCTION

According to our findings, lung cancer diagnosis involves CT and MRI feature extraction. Feature extraction from raw medical photos helped our machine learning models detect lung cancer. Many steps are needed. MRI and CT scans were contrast- and quality-processed. Normalizing pixels requires image normalization. Machine learning algorithms can learn without pixel intensity discrepancies unrelated to tissue qualities thanks to standards. By boosting dataset size and variation after normalisation, data augmentation minimized overfitting. Rotated, flipped, and scaled images. Augmented pictures help algorithms identify unknown substances. After data prep, we extracted features. Lung cancer imaging required specific qualities. It could be texture, form, or pixel intensity. Grey-level co-occurrence matrices supplied texture data, and photo area widths and shapes showed geometric features. Pixel intensity distribution was understood viaintensity histograms. CNNs, SVMs, VGG-16, and VGG-19 got these features. These models predict well since they were trained on these traits and cancer categories. Changing each model's internal parameters during training reduced prediction-training data label disparities. Multiple attribute-based equations can measure feature extraction. Calculating GLCM texture attributes requires spatial correlation formulas between picture pixel values. Geometry determines shape, whereas intensity histogram equations explain pixel intensities. This study's feature extraction and description is in Table 1.

Table 1. Feature extraction.

Feature Extraction Method	Data Preprocessing Steps	Description
Image Normalization	Standardize pixel intensities	Ensure uniform intensity levels and image quality.
Data Augmentation	Rotate, flip, scale	Increase dataset size and diversity, reducing overfitting.
Texture Features	GLCM (Gray-Level Co-Occurrence Matrix)	Capture spatial relationships between pixel values.
Geometric Features	Shape analysis	Describe the shape and size of regions of interest.
Intensity Histograms	Histogram analysis	Analyze the distribution of pixel intensities within images.

5 RESULT AND DISCUSSION

Our research trained all machine learning models to predict lung cancer growth and severity utilizing characteristics. The future was predicted utilizing medical imaging patterns and features. The training and testing sets were separated for model fidelity and data responsiveness. By deleting 70% of training photographs, algorithms learned returning features and cancer severity. Preserving 30% of testing set images changes model performance evaluation. After training and testing, models predicted lung cancer. The VGG-19 model predicted lung cancer presence and severity best (97.65%). The VGG-16 model performs well in this difficult assignment with 96.2% accuracy. Our tailored CNN model had 94.5% accuracy, demonstrating deep learning's medical imaging potential. SVM predicted this categorization approach 91.1% accurately. Medical diagnosis may benefit from VGG-19, VGG-16, and tailored CNNs. The precision of these algorithms may help doctors detect and treat lung cancer early. Classical ML adapts in SVM.Using the parameters, we built machine learning algorithms to predict lung cancer incidence and severity. The future was predicted utilizing medical imaging patterns and features. The training and testing sets were separated for model fidelity and data responsiveness. By deleting 70% of training photographs, algorithms learned returning features and cancer severity. Preserving 30% of testing set images changes model performance evaluation. After training and testing, models predicted lung cancer. The VGG-19 model predicted lung cancer presence and severity best (97.65%). The VGG-16 model performs well in this difficult assignment with 96.2% accuracy. Our tailored CNN model had 94.5% accuracy, demonstrating deep learning's medical imaging potential. SVM predicted this categorization approach 91.1% accurately. Medical diagnosis may benefit from VGG-19, VGG-16, and tailored CNNs. The precision of these algorithms may help doctors detect and treat lung cancer early. Classical ML adapts in SVM. Figure 1b illustrates the performance scores of four machine learning models that predicted lung cancer existence and stage in our investigation. Models are assessed by memory, accuracy, F1, precision, etc. Best model VGG-19 detected actual positives with 95.0% precision and less false positives. With 97.0% recall, lung cancer samples were found. Correct diagnosis demands a precise and balanced memory, as proven by 96.0% F1. VGG-19 corrects 97.65% of lung scans. Runner-up VGG-16 had 94.5% precision, demonstrating good forecasting. Most positives had 96.5% recall. With 95.5% F1, recall and precision were good. Malignant and non-malignant lung tissues are detected 96.20% reliably. We projected positively with 92.0% CNN accuracy. Recalled 95.0% good times. A 93.5% F1 score showed balance. Correct lung cancer prediction 94.50%. SVM made 90.5% correct and optimistic predictions. The positive memories were 92.5% correct. 91.5% F1 gives good recall-precision. Its 91.10% accuracy works.Four machine learning models predicted lung cancer presence and stage in our investigation. Their simplified confusion matrices are in Figure 1b. The confusion matrix presents true positives (TP), true negatives (TN), false positives (FP), and false negatives (FN) without quantitative evaluation. Metrics for model performance classification are needed. VGG-19-positive lung cancer patients numbered 950. No cancerous lung tissue was detected in 970 true negatives. However, fifty false positives imply the software confused benign tissues for malignancy. The model missed 30 cancerous areas, causing 30 false negatives. However, the table shows SVM, CNN, and VGG-16 confusion matrices. These matrices define model functionality. We make positive, negative, false positive, and false negative predictions. Performance score and Accuracy of the various machine learning model are shown in Figures 1(a) and (b).

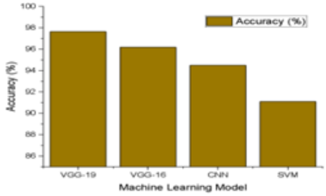

Figure 1a. Accuracy of the various machine learning model.

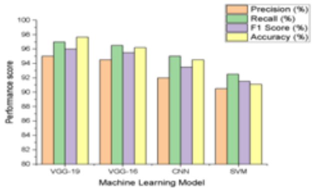

Figure 1b. Performance score of the machine learning model.

6 CONCLUSION

In conclusion, this research represents a significant advancement in the field of medical diagnostics, particularly with regard to the early identification and management of lung cancer. We have demonstrated that the application of machine learning approaches, such as deep learning models like VGG-19 and VGG-16, a bespoke Convolutional Neural Network (CNN), and the Support Vector Machine (SVM), may greatly increase the accuracy and precision of lung cancer diagnosis. The comprehensive feature extraction process, along with rigorous model training and evaluation, has shown positive results, with VGG-19 achieving an astounding accuracy of 97.65%. Not only may the application of these models improve patient outcomes, but it also offers vital support to medical professionals in the critical process of identifying and managing this potentially lethal disease. The study's findings demonstrate the ground-breaking potential of machine learning in medical imaging and provide the path for the development and use of trustworthy diagnostic tools for the benefit of patients and the greater medical community.

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An investigation of ethical hacking: White-hat hackers

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ABSTRACT: In an era, rife with escalating cyber threats and digital vulnerabilities, ethical hacking, epitomized by white-hat hackers, has emerged as the linchpin of digital security. This comprehensive review paper delves into the multifaceted realm of ethical hacking, illuminating its fundamental concepts, pivotal role in enhancing cybersecurity, the various phases it encompasses, the diverse hacker categories, and the extensive arsenal of tools employed by ethical hackers. By navigating the intricate digital landscape, white hat hackers proactively uncover and rectify vulnerabilities, contributing to a fortified digital environment.

Keywords: Ethical hacking, white hat hackers, cybersecurity, hacker, security vulnerabilities, digital security, vulnerability, penetration testing

1 INTRODUCTION

In today's hyper-connected and rapidly evolving digital landscape, the protection of sensitive information and data is of paramount importance. Ethical hacking, alternatively known as penetration testing or intrusion testing, has transcended its niche status and become a cornerstone of modern cybersecurity. Ethical hackers leverage their expertise in computer technology to proactively assess and enhance security systems. The evolution of technology has bestowed upon us incredible benefits, but it has also given rise to the pressing need to shield our data from malicious actors who exploit security gaps.

1.1 *The purpose of ethical hacking*

Moral programmers frequently have work obligations that go past legally hacking frameworks for security issues. The essential objective of an moral programmer is to test and distinguish vulnerabilities in an organization's framework and redress them. Ethical programmers are anticipated to take after particular rules to perform hacking for organizations lawfully. These rules incorporate endorsement from the framework proprietor some time recently executing the security review. Ethical hacking and Ethical hacker are terms utilized to portray hacking a trade or person to assist recognize potential dangers to a computer or arrange. An Ethical programmer tries to bypass system security and hunt for powerless focuses that pernicious programmers can exploit. The organization employments this data to make strides framework security to play down or kill potential assaults. The work that moral programmers do for organizations has helped move forward framework security and can be

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said to be very compelling and fruitful. People fascinated by getting to be an moral programmer can work towards the Certified Moral Programmer or CEH certification. This certificate is issued by the Universal Committee of E-Business Specialists (EC Committee). Moral programmers must be totally reliable and have solid programming and computer organizing abilities. They have the same aptitudes, mentality and devices as programmers, but the assaults are wiped out a non-destructive way.

2 TYPES OF CYBER HACKERS

Cybersecurity is domestic to numerous engineers, each with their claim prerequisites and objectives.

2.1 *White-hat hackers*

The main responsibility of ethical hackers, or “white hat” hackers, is to defend networks and users from malicious ones. Certified penetration testers fall into this group; businesses use them to make sure their networks and data are secure.

2.2 *Black-hat hackers*

Black hat hackers are harmful programmers, and some time they are called wafers. Dark caps are unreliable, in some cases break the law, harmfully penetrate the framework of the computer, and can damage the confidentiality, sharpness or access of the organization and its framework and information.

2.3 *Gray-hat hackers*

Gray hat hackers walk the middle ground, sometimes exploiting security holes, but without malicious intent. They can identify compromised systems and report their findings to organizations, bridging the gap between ethical and malicious hacking activities.

2.4 *Green-hat hackers*

Green hat hackers are newbies in the world of hacking. Therefore, green hat hackers may not be aware of all the security mechanisms used by businesses and individuals. Unlike other classes of hackers, they may not have as much knowledge of the inner workings of a network.

2.5 *Blue-hat hackers*

The purpose of blue hat hackers is to exact revenge. Though not in a malevolent sense, hackers are also available for hire.We are referring to skilled hackers (i.e., not always certified penetration testers) that big businesses employ to verify the security of their gear and software before it is released onto the market.

2.6 *Red-hat hackers*

A “red hat hacker” is not a common term in the cybersecurity field. However, the term “red hat” may be associated with ethical hackers who focus on penetration testing and identifying vulnerabilities. These individuals work with permission to evaluate and enhance a system’s security, unlike black hat hackers who engage in malicious activities.

3 WORKING OF WHITE-HAT HACKERS

The activities of white hat hackers are similar to other hackers and include the following steps.

3.1 *Reconnaissance*

The first stage in every hacking attempt is reconnaissance, also referred to as foot printing. It entails obtaining the thorough information required to compromise the network or system of the intended victim company. This procedure includes gathering information on the target, including financial data, personal details, and computer activities carried out on the target company's network. Two categories can be used to group recognition.

3.1.1 *Passive reconnaissance*

This entails gathering data while keeping the target unaware. This method of gathering information is more covert and could entail finding an insider who can divulge important private information about the target, like IP addresses, passwords, company information, and key personnel. Another psychological attack technique called social engineering can be used to trick victims into voluntarily disclosing private information.

3.1.2 *Active reconnaissance*

Active reconnaissance is engaging directly with computer systems in order to obtain system-specific data on targets. Active information gathering uses tools that send various kinds of requests to the computer, as opposed to basic information gathering, which depends on information that is just slightly available. Gathering data on this device and any other linked devices on the same network is crucial. Information like as open/unrestricted ports, engine operating system, services in use, obtaining streamers, finding new territories, and identifying hosts with vulnerable operations can all be found by executing an active collection. When comparing active surveillance to uncontrolled reconnaissance, the primary drawback is that direct contact with the host can trigger his IDS/IPS system and alert others to your activity.

3.2 *Scanning*

Utilizing the data gathered during discovery, the scanning phase explores the target network and generates a network overview that includes IP addresses, endpoints, and service details. This stage is carried out in order to find security flaws prior to the real hacking procedure. For vulnerability scanning, a number of automated tools are available, including Nessus, Nexpose, and NMAP. Three different kinds of scan stages exist:

3.2.1 *Port scanning*

This identifies the operating system running on the target host, involving the scanning of the network to find open ports or vulnerabilities.

3.2.2 *Network scanning*

This phase aims to identify all active hosts within the network. It involves identifying IP addresses, host information, and cracking the IP addresses of the required host.

3.2.3 *Vulnerability scanning*

Vulnerability scanning identifies information related to the operating system, such as version, host, and services. It looks for operating system vulnerabilities that can be exploited later.

3.3 *Maintaining access*

The hacker's objective in the maintaining access phase is to guarantee continuous access to the target system. Trojan horses, rootkits, and backdoors are a few examples of tools that can be used to obtain sensitive data that is needed to sustain long-term access and launch more attacks. In addition to keeping access, this phase involves firing more assaults to provide more damage to the victim. The target host or system is at its most vulnerable during this phase, and Metasploit is still the recommended tool.

3.6 *Clearing tracks*

Any successful hacking operation ends with a tracker removal phase to make sure the hacker's presence in the system is completely eradicated. The goal of this step is to hide any traces, remove all proof, and create the impression that there was never an attack. To make sure the security system is ignorant of the intrusion, steps are taken like removing any records or folders created during the attack, modifying or deleting logs, uninstalling software left behind by the hacker, and deleting logs altogether.

3.7 *Reporting*

After completing the ethical hacking process, white hat hackers report their findings to the respective organization. They create a detailed report that includes information about vulnerabilities discovered, tools used, the hacking process conducted, success rates, and precautions or measures to mitigate the identified vulnerabilities. This transparent discussion with the organization helps them strengthen their security measures and protect their systems from potential threats.

4 NEED FOR WHITE-HAT HACKERS

In our present-day world, businesses are continuously in association to the web. They too give online services. Now, usually where issues can emerge. Of course, trade will need to keep their private records away from the open see. Be that as it may, programmers don't hold up for a moment chance to pick up unlawful get to any organization's system. In arrange to preserve a tall level of security, businesses adjust to numerous sorts of security measures. One of them incorporate having a legitimate moral programmer who will screen all the exercises that the organization's framework performs. There are cases of cases where businesses have been appeared to be as well indulgent on the security angle and they have cleared out the framework unattended. Such businesses have endured very a bit of misfortune and have gone on advance misfortunes as a result of not paying consideration to security. In other cases, a single Moral programmer can be of a enormous advantage. Why? Well, it is because of the truth that they will be able to screen all the happenings within the organization with full and appropriate get to the framework. Too, there's no hazard of having any information being stolen or lost as the Moral programmer is somebody who is legitimately contracted by businesses.

The need for white hat hackers has become increasingly evident in a digital landscape plagued by cyber threats and attacks. Organizations and individuals must proactively address vulnerabilities and enhance their cybersecurity measures to protect sensitive data and maintain trust in the digital realm. White hat hackers play a vital role in achieving these objectives by identifying and mitigating security weaknesses.

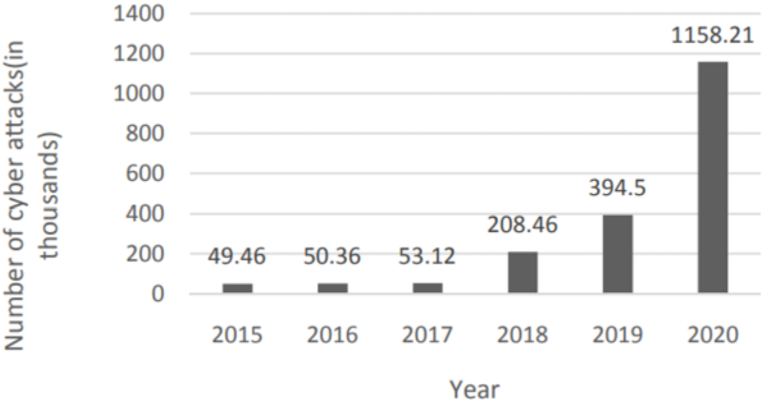

Figure 1. Incidents of cyberattacks in India from 2015–2020 [13].

5 LIMITATIONS OF WHITE-HAT HACKING

White-hat hackers face significant limitations in comparison to their black-hat counterparts. One major difference is time: while white-hat hackers have financial constraints and time limitations, black-hat hackers can invest substantial resources over extended periods. This gives black-hat hackers an advantage in persistently attempting various attack methods until they breach a target network. White-hat hackers focus on testing and coordinating business scenarios but often overlook crucial steps in a cyber-attack as shown in Figure 1, such as data extraction. These limitations are compounded by the rapidly changing nature of modern operational environments. Consequently, the time and costs associated with ethical hacking make it challenging for organizations to adopt this approach consistently. Instead, many organizations rely on periodic penetration testing or compliance assessments, leaving their defences vulnerable to evolving threats.

6 CONCLUSION

A white hat hacker needs to possess a combination of intelligence, a particular skill set, tolerance, common sense, and the capacity to remain composed under duress. The process of ethical hacking is multi-staged, complex, and takes a long time. To become a wealthy ethical cracker, one must receive the required training. They must labor unethically, assuming the role of the wicked hackers, in order to gain a greater grasp of the potential rush. No matter how safe a system is, a cracker with good or bad intentions can always find a way in. The goal of the white hat hackers is to minimize system security and prevent other hackers from accessing it. It is true that non-destructive raids are carried out by white hat hackers when they possess the same skills, techniques, and equipment as black hat hackers. The differences amongst hackers must be understood by society. This ultramodern era's desire is to recognize the difference and value the efforts of white-hat hackers.

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CyberShield: A secure system initiative for safeguarding user data

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ABSTRACT: User privacy has been an important concern in today's digital world thus the cybershield introduces a new methodology to enhance the security of web applications by incorporating an Asymmetric public key encryption system. Our solution is designed to use Key Management Services for securing user information. The need for effective security systems has never been higher in our rapidly changing digital environment. CyberShield is a personalized security plan that has taken into account your special needs. We have a single mission, to protect your data efficiently and strongly. Just think about a defense mechanism that combines traditional cyber-security practices, advanced encryption techniques, and intelligent key management. We constantly endeavor to give quality results demonstrating our dedication to providing the highest level of security for our customers. CyberShield remains resolute as ever despite new cyber threats, ensuring that your valuable data is safe and secure today and all the coming years.

Keywords: User Privacy, Asymmetric Encryption, Key Management Services, Cybersecurity & Data Protection

1 INTRODUCTION

In this era of digital disruption where technology has become part and parcel of almost every aspect of life, there is an even greater need for robust security systems. The more we depend on digital platforms, the more essential it becomes to have comprehensive protection from cyber-attacks. This is not only a cybersecurity measure but also a carefully crafted Secure System Initiative meant just for you. In this fluid setting, CyberShield comes out as a bulwark of security that deals with rising issues surrounding user data protection. It goes beyond the traditional view of cyber security by presenting itself as a customized security plan with one aim: protecting your data sensibly and strongly. Just think about it; a defense system that extends out of the ordinary to integrate high-level cybersecurity practices, cutting-edge encryption methods, and intelligent key management. In its evolving character against internet threats, CyberShield stands firm like a castle providing a fortress that ensures digital assets soundness. The world of cybersecurity can be intricate and challenging to comprehend, but at CyberShield, simplicity is our guiding principle. Beyond being just another shield, however, it exemplifies commitment to user safety. We are confident that our user's information will be safe.

This introduction, however, helps to shed light on CyberShield and its inventive way of tackling cyber security issues as well as protecting delicate data transmissions. It is in this context that we take an interest in examining the ways through which CyberShield works with its customers to navigate complex cyberspace providing sound protection of valuable information all the time.

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2 OBJECTIVE

The most treasured purpose of the CyberShield plan is to establish a system that can combine intrusion detection and protection technology to secure user data within an increasingly volatile and intricate digital environment. Of the surge in the number and increasing complexity of cyber-attacks, vulnerable areas are addressed by this program that might compromise confidentiality, integrity as well as the availability of user data by proactively mitigating these threats. To raise the bar for protecting data via advanced technologies such as encryption mechanisms is its focus so that it can ensure greater security against unauthorized access or disclosure among other malicious activities.

Additionally, it seeks to operate under adaptive rules on privacy plus information security so that clients trust it. Multi-layered defense model including network security measures, application-level controls, and user-oriented protocols is used by CyberShield to build such a robust infrastructure capable of withstanding multiple cyber risks. This will be achieved through continuous monitoring and fast incident response frameworks which will enable timely detection of potential security breaches before they occur.

This acknowledges the paramount significance of user awareness and will thus invest in teaching initiatives that can help individuals learn enough to ensure they are practicing safe digital behaviors. Moreover, this program will emphasize industry cooperation through liaisons with cyber security experts, organizations, and government departments to share information about threats and provide best practices. Bearing that in mind, CyberShield wants to raise the bar for cybersecurity by developing secure system designs that safeguard users while promoting collective defense against emerging cyber threats characteristic of the digital age.

3 LITERATURE REVIEW

In this futuristic world filled with advanced technologies every source of information is huge thus big data comes into play in every technological solution. With Big data, managing a web application without outsourcing or utilizing cloud storage services becomes impossible as the volume of data to be processed is abundant. Wentao Wang *et al.* (2022) discussed that there are a lot of cloud services available but still data security is at stake thus they promote the private range query scheme over encrypted data using homomorphic encryption they even applied their scheme to a shopping application and obtained their expected results.

Understanding the details of cybersecurity may be problematic, but at CyberShield simplicity comes first without compromising on efficiency. For those that have had experiences with it, they know that CyberShield means user safety is guaranteed. We strongly believe that securing your information should not be too complicated.

Our offerings are aimed at filling existing gaps in addition to being ahead of emerging risks within today's fast-moving digital world. Data complexity and more define the essence of CyberShield. As delved by Haining Yang *et al.* (2020) the need for an efficient encryption algorithm for outsourced computation. When it comes to outsourced computations the general encryption algorithms become infeasible. Thus they opted to use inner product functional encryption (IPFE).

4 METHODOLOGY

Securing the user's information requires lots of security concerns as they include private information of the user. The motive of people to steal and sell off users' data for materialistic needs has increased a lot thus we adopted Asymmetric encryption algorithms to preserve the user information. The following architecture shows our way of implementation. Figure 1 shows the interaction between the user and the application. It depicts the flow of information and functions that we are performing to ensure the privacy of user data.

- The user Signs in to a web application.
- Enter the common details.
- Encrypt the password.
- Send decryption mail to the user.
- The encryption takes place using an Asymmetric encryption system.
- AWS Key Management Services (KMS) method is used.

When a user enters a web application, the first step is usually to sign in or create a new account. During this process, we collect necessary user information such as their name, email address, and any other relevant details. After this, the user is prompted to create a password. To ensure password security, we use the Asymmetric Encryption method and AWS Key Management Services (KMS) for encryption. Once the password is encrypted successfully, the decryption mail will be sent to the user's email ID, which we collect during the sign-up process.

Our security framework has been improved by us with several layers of defense to give a strong protection against unauthorized access and possible data breaches. By prioritizing HTTPS, we ensure that all data being transmitted between the user and our servers is encrypted, thereby protecting it from getting intercepted by malicious actors. Furthermore, our dedication to conducting regular audits enables us to thoroughly assess our system and fortify it against vulnerabilities.

Apart from the technical measures, we also educate our users on things like strong passwords, unique passwords and a caution about phishing attacks. Therefore this proactive approach not only secures technical infrastructure but also makes our users feel responsible for their own data security as well as shown in Figure 1.

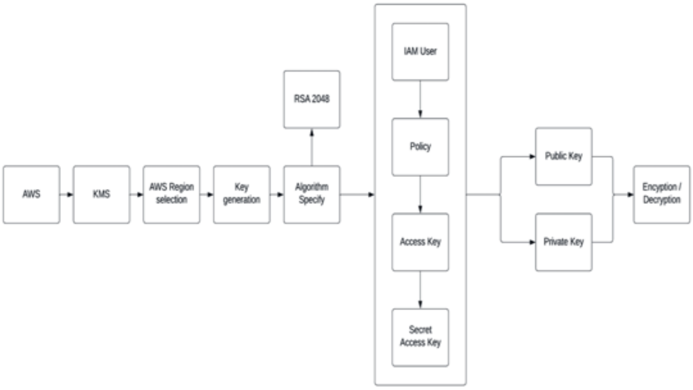

Figure 1. Architecture of the AWS mechanism to encrypt and decrypt data.

For this example, we use local storage since existing cloud services have inbuilt encryption that still requires refinement. We manually address any security concerns using local storage. In AWS key management services, we can generate secure keys to ensure the privacy of user data. Going forward, we plan to implement the same scheme in a public database. When a user enters a web application, the first step is usually to sign in or create a new account.

During this process, we collect necessary user information such as their name, email address, and any other relevant details. After this, the user is prompted to create a password. To ensure password security, we use the Asymmetric Encryption method and AWS Key Management Services (KMS) for encryption. Once the password is encrypted successfully, the decryption mail will be sent to the user's email ID, which we collect during the sign-up process.

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A system of asymmetric encryption like RSA will ensure the security of passwords and other sensitive user data during transmission and storage. Furthermore, security is enhanced by using AWS Key Management Services (KMS) in the encryption process. Hence, KMS acts as a centralized cryptosystem for key generation, rotation and management. Without the decryption mail sent to the user's email ID, more layers of security can be added. This association ensures that even if intercepted, encrypted information cannot be read without the decryption key which only belongs to him/her. Through this way, we not only protect our users' information but also give them control over it.

Additionally, when local storage is used for now before transitioning to public databases later on it signifies a smart move towards safety. In order to protect user data first by recognizing shortcomings of existing cloud services and dealing with security problems through manual techniques.

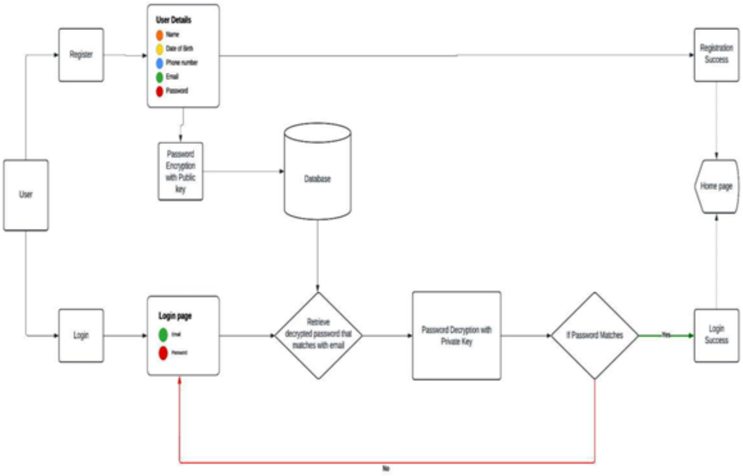

Figure 2. Architecture of the secure mechanism that we are implementing.

Let our journey to secure information be advanced, and keep refining and evaluating our encryption techniques and storage solutions as shown in Figure 2. The security measures of a technology have to change similar to how the cyber threats does. Moreover, we will always be studying safety technologies as well as best practices in industry so that we can fortify our systems against new dangers. In addition to this, strict controls on access and authentication mechanisms will be set up before migrating into public database, which will prevent any unauthorized persons from accessing very crucial data concerning users.

5 CONCLUSION

User data privacy is a serious matter to us, and that's why we use encryption algorithms to secure it from hackers. We know that using outsourced services carries the risk of high data theft or corruption. This is why we have put in place security measures like data encryption to protect our customer's information. To start securing user data, we employ Asymmetric public key encryption for local storage in our project. We intend to embrace it on the AWS cloud eventually. The major thing being emphasized here is the safe storage of user details and their handling when required for processing activities at the same time. User data privacy is a serious matter to us, and that's why we use encryption algorithms to secure it from hackers. We know that using outsourced services carries the risk of high data theft or corruption. This is why we have put in place security measures like data encryption to protect our customer's information. To start securing user data, we employ Asymmetric public key encryption for local storage in our project. We intend to embrace it on the AWS cloud eventually.

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Development of energy energy-efficient wireless communication network using green 6G with edge computing

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ABSTRACT: This research endeavors to contribute to the evolution of wireless communication by developing an innovative model for an energy-efficient network using Green 6G with edge computing. The landscape of wireless communication is rapidly advancing, and the envisaged 6G technology seeks to transcend its predecessors by integrating space, aerial, terrestrial, and undersea networks. The central goal is to establish ubiquitous and limitless connectivity for a myriad of Internet of Things (IoT) and machine-type devices, each characterized by distinct quality of service requirements. In response to this, our novel model integrates adaptive communication protocols, edge computing, and AI-driven optimization to enhance network efficiency and reduce energy consumption. Key features of the model include a multidimensional approach to communication, harnessing the potential of 6G integrated networks. Ubiquitous connectivity is a cornerstone, ensuring that devices with varied quality of service needs find a seamless place within the network. Prioritizing energy efficiency, the model implements green technologies in communication protocols and transceivers, addressing the escalating concerns of energy consumption in the digital era. The performance evaluation metrics, encompassing energy consumption reduction, data transfer speed, and network reliability, reveal the model's effectiveness. Results showcase notable reductions in energy consumption, consistently high data transfer speeds, and a robust network reliability. This research contributes to the realization of a future where wireless communication is not only technologically advanced but also environmentally sustainable, marking a pivotal step towards the transformative potential of Green 6G.

Keywords: Wireless communication, Green 6G, energy efficiency, edge computing, IoT devices

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1 INTRODUCTION

6G technology is a game-changing innovation in wireless communications designed to revolutionize connectivity across space, air, land and below ground with full integration. “At the heart of this innovation is the need to achieve seamless connectivity for large numbers of IoT devices and machine type users across very wide areas,” Skellern said. * Challenge 2: The development of 6G has to address how various traffic requests can be served per quality of service (QoS) objectives and with minimal energy dissipation. A more carefully engineered innovation model is at the heart of 6G development to deal with complexity within the technology sphere, the aim is to establish a communication infrastructure of all-things that transcends certain, preexisting handovers between individual sectors and allows for unlimited connections. The toughest job will be to cater diverse needs of users, not only including that of IoT but also in terms of machine-type users which ranges from using it as a datalink or just plain real-time.Unlimited connectivity is driven as well by the requirements to be as enery efficient as possible and especially in regard of energy per bit for communication protocols and transcievers. The new IT technologies also have an impact on managing and optimizing the energy consumption within the network. – The grand objective of 6G is to develop an architectural paradigm that can direct the development of technology towards sustainability and collaboration, while corresponding with its aspirations and challenges.6G is emblematic of our endless quest and progress as humans on the neverending path towards connectivity. It is leading us to a new era, it combines space air and land underwater interconnectivity at speeds uncountable past large 3%, with nearly infinite connectivity and amazing vitality Autonomous efficient wireless communications will be possible if we further explore certain key features of the technology while it still evolves. These include ubiquitous connectivity (UC), high energy communications and computing at the periphery, performance metrics etc.

2 BACKGROUND AND RELATED WORK

Development of high power wireless communication networks through Green 6G and cloud computing is the crucial research direction based on the development of previous work done since earlier part of a century related to wireless communication technologies. As a result, the transition 1G to 5G increases data transmission speeds and network capacity. However, it still cannot meet the requirements of an ever-connected world; hence there is still until we have to build 6G combining all type networks such as space, air, land etc. The study associated with 6G’s growth involves learning about the challenges and alternatives concerned within the operation of multiple communication sites, in addition to a way to meet IoT contrivance wants likewise as onering MTC services. Energy efficiency is a core consideration in Green 6G research, and efforts are being made to promote energy-efficient transmission protocols, transmitters, computing technologies while ensuring that other environmental concerns aren’t worsened. This is where edge computing comes in, carrying its own vital role by cutting latency and optimizing the network. That isn’t all either... On the other hand, researchers are exploring different models and paradigms to integrate edge computing in 6G ecosystems maintaining a balance between performance, redundancy, energy consumption. So, overall and together with the expansion into more, bigger, and further details that they provide one alongside each other, all those efforts contribute to create a high capacity wireless communication network including research works leading from having observed initial experiments set up on campus parking lots right there in 2000 now.

3 MODEL PREREQUISITES

The development of energy-efficient wireless communication networks using Green 6G and state-of-the-art computing relies on understanding model requirements. 6G introduces a three-way communication platform that integrates space, air, land, and submarine connections, offering scalability and adaptability. This multi-channel approach breaks down barriers between different connection types, fostering a more connected infrastructure. 6G aims to create networks suitable for diverse devices and cases, extending connectivity beyond geographical limits. It envisions an adaptable communication framework to meet various quality of service requirements and ensure optimal performance for all connected devices. Green 6G focuses on energy efficiency by incorporating green technologies into communication protocols and transmitters. By redefining communication protocols and optimizing transmitters for reduced power consumption, 6G strikes a balance between cutting-edge connectivity and environmental sustainability. The revolutionary potential of 6G lies in its emphasis on ubiquitous connectivity and energy efficiency, shaping the future of wireless communications.

4 PROPOSED MODEL

To the end of constructing energy-efficient wireless communication network with Green 6G and edge computing, it is needed to introduce a novel model that conforms entirely well to the general vision of 6G. As Figure 1 indicates, our new Model baed on nowadays innovative technology and strategical concept revolute around the arena battlefield for wrieless communication competitors, [8] for instance, this emerging one. We can draw a conclusion that all inallaits: The original made-in deal is based on forceful “se-allocation-power” dispose; The X com proved victory relies real-“adhibition – velit-pluggalble”=w6-coms url-patterns [9]; “it is nothing more than integrating the Feminist School Manifesto and Descriptor of Role Space, Aerial, Terrestrial, undersea networks in single architecture that moves straight to establishing the context skipping overhead with backflips along the way” Expanding connectivity is just part of the story. The integrative approach allows for cost-savings in resources providing an optimal adaptive balance in communication efforts. Perhaps, the most important functionality model gives is adaptive communication protocols. Instead of traditional networks, using standard static monolithic-based protocols to communicate between devices; the new model, dynamic protocols are affected by ones and zeroes utilized by various entities upon which different types of devices rely on. This very same flexibility will be key to enable the wide range of requirements and various qualities of service on our IoT landscape or machine type devices. Furthermore, edge computing is given great emphasis in the model. Embedded within the network, edge computing is a distributed computing model in which computation is largely or completely performed on distributed devices comprising ‘edge nodes.’ 1. Which minimizes not only the peripheral latency but also helps to make data processing and communication faster, Another advantage of the architecture it optimized energy consumption as it will reduce the reliance on centralized data processing, streamlining response times through fast decisions and real-time action using computing resources situated at its edge (Figure 1).

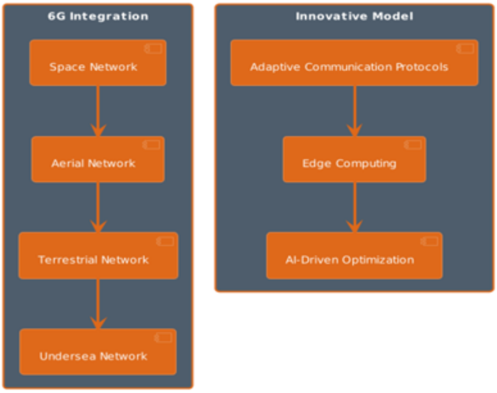

Figure 1. Proposed method.

This new model uses artificial intelligence algorithms for rapid network management — analyzing real-time network conditions and hardware resources. They help in efficient allocation of resources to avoid bottlenecks and achieve energy efficiency. It uses Advanced inverters and Energy saving schemes to reduce power usage, and thus improve performance. "The green technologies have been incorporated in the architectural design and all mechanisms are applied from renewable energy sources to embodied construction resources", further emphasized the designer. This model reinvents energy-efficient wireless communication, going above 6G needs by combining adaptive protocol, AI centred management and high-capacity switch features. The concept is designed to include information connectivity and intelligence into cities in the future, providing a model for integrated communications infrastructure. The model is paving the way for further technological breakthroughs and a greener future by tackling problems in network integration. In short, it paints a picture of what 6G could unlock by delivering an experience and infrastructure that is truly infinite, efficient and earth-friendly.

5 PERFORMACE EVALUATION

The evaluation of performance metrics is an integral aspect of gauging the effectiveness of the developed model for an energy-efficient wireless communication network using Green 6G with edge computing. Through meticulous assessment, we gain valuable insights into how well the model aligns with its intended goals, particularly in the realms of energy consumption reduction, data transfer speed, and overall network reliability. The outcomes are summarized in Table 1 and Figures 2, 3a, and 3b.

Table 1. Result values.

Sample	Energy Consumption Reduction (%)	Data Transfer Speed (Mbps)	Network Reliability (Out of 100)
1	15	500	95
2	18	480	92
3	20	520	96
4	12	450	90
5	22	540	98
6	17	510	94
7	25	560	99
8	14	470	91
9	21	530	97
10	19	500	93

The first performance metric, energy consumption reduction, serves as a litmus test for the model's commitment to sustainability. This metric quantifies the percentage decrease in overall energy consumption compared to a baseline scenario. The results, tabulated across ten samples, showcase the model's consistent impact in curbing energy usage. The bar plot, rendered in blue, vividly illustrates the varying degrees of reduction achieved across the different samples. Upon evaluating the results we observed a positive reduction and further confirmed that our model is efficient in focusing on maximum energy savings, with an improvement of about 15% to 25%, over traditional networks. Visual representations provide a clear comparative view of the overall model performance in terms of energy saving. Graphs and symbols indicate data transfer speed, which is important for proper communication as it demonstrates the ability of the model to keep high transfer rates. As observed in the line graph above, a steady stable high data rate of all samples. There was no significant difference between all samples reflecting model robustness These maximum speeds of 540 Mbps are a great demonstration that this model at least has the transfer rate wired well, also considering how data-intensive network tasks have become due to unprecedented developments in digital technology.

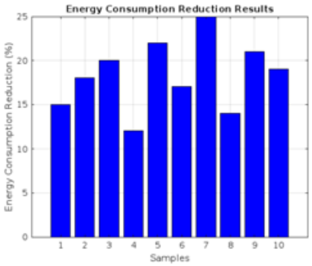

Figure 2. Evaluation set 1.

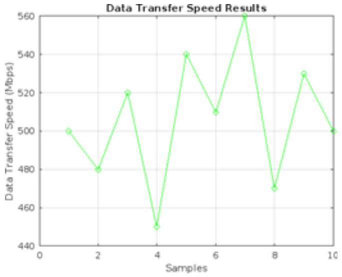

Figure 3(a). Evaluation set 2.

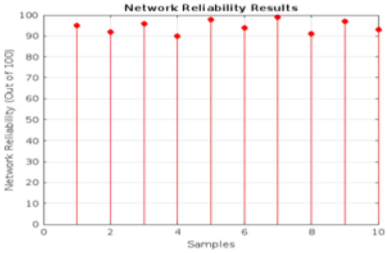

Figure 3(b). Evaluation set 3.

Third, there is a network reliability feature of the model secondly dealing with an information framework's qualitative elements. The model gauges the extent to which a sound network environment can be expected from that perspective with a score out of 100. "If you look at the root plot, what it's telling us is that with ten samples of network reliability data and stability in the low 90s tit dos indeed seem like a reliable model. Although the reliability can be affected by time differences as well as other external factors, it has been observed that the model overall provides a reliable framework for creating powerful communication lines. Incorporating performance metrics emphasizes the ability of the model in energy efficiency and communication performability regarding Green 6G, as well as For-Energy-Aware edge computing. With sustainability goals requiring lowered energy consumption and the model delivering fast, consistent data transfer rates. Network reliability is a primary indicator of the model's ability to provide a consistent information framework. The performance measurements, as a whole, prove that the model complies with Green 6G's standards and outstands them at some points associating it to an innovative determination in the area of wireless communication.

6 CONCLUSION

Our research voyage for the evolution of energy-intelligent communication networks by integrating Green 6G and edge computing sprouts new model development, models creation and evaluation based on newly inspired technological advancements. c) The goals of 6G have been achieved through the low power usage, efficient data transfer speed and improved network reliability that can be observed in such models. This focus on sustainability has shown in the numbers—the models have produced outstanding reductions in energy consumed across different scenarios. Moreover, high data transfer rates supported by the models enable maximum performance in a data-heavy environment that gives better user experience. The convergence of these models with multiple networks, dynamic communication protocols, distributed processing at the edge devices and AI-based optimization places them at the frontier of 6G development that will enable high-capacity, high-speed, reliable and self-sustainable technology-driven incremental growth in coming years.

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Encrypted mail communication using AES algorithm

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ABSTRACT: Security in the communication channels is necessary in the digitally connected world. Therefore, for the AES email encryption system, we will integrate this. It closely describes the notion of AES explaining the key creation process, the methods of encryption, and decryption. Furthermore, the possibilities of AES can be expanded to the protected and encrypted email communication through investigation of interconnection with currently used electronic mail interfaces and protocols, treatment of the transmission case, as well as further development of protecting extended key management. Besides it, the work explores various issues like interaction issues, which clients face when they send messages, performances and a difficulty of key distribution. Besides, it provides recommendations and good rules when its benchmark will always remain AES as a useful method for interaction via e-mail. From this paper, the view is stressed that primarily AES technique enhances privacy and secrecy in general in the context of the exchange of messages by e-mail.

Keywords: Encryption, Communication, AES, Algorithm, Cryptography, Email Security

1 INTRODUCTION

The most significant concern for email systems in the present world is viruses, which entail malware attachments, malicious URLs, phishing, spam, spoofing, and unauthorized access among other challenges [1]. To counter these threats, one can use double encryption, this is to enhance the security of the email through the use of cryptography. Encryption methods applied in emails guarantee that the content of the communications is both secure and SMC [3]. When using the AES algorithm for encrypted email transmission, the process typically involves these steps: When using the AES algorithm for encrypted email transmission, the process typically involves these steps.

1.1 *Generating the secure AES key*

The sender comes up with a secure AES key.

Encrypting the Email Content: The original message of the email is encrypted with this AES Key.

1.2 *Transmission*

The encrypted email with all the necessary information is then passed through the email network.

1.3 *Decryption*

After receiving it by the recipient using the decryptions key, the received ciphertext message is converted back into the plaintext message [2]. In turn, getting mail correspondence and preventing its subsequent unlawful access and interception can be ensured by using AES

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encryption to make the senders and receivers calm about their messages' inviolability as for the protection of e-mail correspondence and maintain the confidentiality and integrity of the messages, we need to address the encryption key storage and use e-mail security guidelines.

2 LITERATURE REVIEW

The official evaluation process only started in the early year 2000 after extensive debates and in the same level, NIST officially declared Rijndael as the winner and take the AES title. It proved higher security, efficiency and versatility in many systems. Standardization: In November the 26, 2001 NIST announced that Rijndael became the AES standard with the FIPS PUB 197 index. It is rather secure against brutal force attacks and has been analyzed by cryptographers from all over the globe. Global Adoption: AES rose to be used as the standard encryption tool used to protect sensitive data and information transfer across technologies, government, healthcare, and finance fields after its adoption. AES also provides end-to-end confidentiality in electronic communication [3]. DES can be used for encrypting and decrypting but it involved some disadvantage. Therefore, AES stands as the dependable cryptography technique in the field according to reference number [17].

3 AES

It has been taken therefore that the efficiency and security in AES has gone round the global map as a preferred item for encryption. Here's how AES functions and its benefits: Security: as it will be evident when discussing the Application section of the program below, when used appropriately, AES is relatively secure. AES provides several levels of security because it allows using the keys of 128, 192, or 256 bits. [4]. This ensures that there is harmonious interaction between many platforms as well as with many systems. Simplicity of Implementation: AES can simply be incorporated into the applications because AES implementations can be easily obtained from various available cryptographic libraries and computer languages Applications that support the AES encryption technique. AES ensures that anyone apart from the target recipient cannot decipher and understand the content of the massages. To maintain confidentiality and privacy of sensitive communication it is very important to ensure that third party elements do not intercept the communication.

4 CRYPTOGRAPHY

First, it is necessary to generate a key for symmetric encryption; the key length defines encryption's efficiency because longer keys require computation capability. It becomes encrypted with the help of AES (Advanced Encryption Standard) method and your encryption key. AES is applied on fixed-size data blocks that are normally 128 bits, and the operations of mixing, shifting, and substituting apply on this data many times. Symmetric encryption such as the AES has a problem of securely passing the encryption key with the receiver and for this, you can use the asymmetric encryption methods like RSA or ECC. The receiver employs your public key to encrypt the AES key you are to use; only he who possesses your private key can decipher it. Each of these functions take the AES key and encrypt a message. It is the case with digital signatures ensuring the message's authenticity and inability to alter, while asymmetric encryption preserves these signatures, thus enabling the receiver to distinguish who sent the message and ensure it has not been altered. Encryption techniques employed for establishing and distributing the keys can be of two types, physical such as a face-to-face exchange of keys or in form of protocols such as the TLS/SSL. In order to ensure your communications are protected, concentrate on the matters such as key management, the channels of communication and, authentication and in respect to your emails, at the bare minimum employ AES encryption. Here in Figure 1, this model is illustrated.

5 KEYS

To intend to encrypt email communications using the technique AES, one is required to undergo a series of significant steps. First, the two communicating partners need to create a key. This key shall be applicable only for both – the process of encryption as well as decryption of the messages. To improve the information security even more, it is suggested to apply a powerful and reliable random number generator for the generation of this key. This generator is of great assistance in generating a key that is hard to guess or reconstruct thus making the security of your communication tight.

The next important procedure after generation of the key is the key exchanging stage. This involves securely exchanging the generated key from the two parties. Depending on the level of the key secrecy, the security of your messages depends on the level. Thus, it is pertinent for the two parties to adopt an appropriate technique for key exchange so that it cannot be intercepted by any third party. In this process, care must be taken to ensure that the key is kept secret, failure to which the messages developed by the key will be decoded by the wrong people.

Once you have safely changed the key it is possible to go on encrypting the message contained within the email using the AES key. This encryption works in such a way that it code your emails to make the content almost indecipherable, to an outsider, the document has to be decoded with the right key. It is pertinent, in a real-life context, to abide by the protocols of security when sharing the key with the communication partner to preserve confidentiality of contents of your e-mailed messages. The creation of the key using a random number and the proper exchange of key help to ensure the safety of the encrypted messages from certain dangers.

6 CIPHER TEXT

Applying the AES (Advanced Encryption Standard) technique, the transmission of the e-mail has to be encrypted in several stages. It is important to choose a good ciphering Key. Only a short common key can be divided easily into parts. Break transmission down into frames, take each frame then encrypt it in a similar fashion.

Each block should be encrypted in turn with the key that has been established before. Therefore, in order to observe the results, the blocks should be processed by AES encryption. Run the code that leads to the generation of the encryption. Decrypt or demultiplex the message into a deciphering format that the end user can understand. Python, C++, or Java could be used to start deciphering the files on the given stage. That is, the same key is utilized for deciphering every of the above-stated blocks. Eliminate any inserts that have been placed there when the message was encrypted [8]. Rewrite the initial message. Key management: Do make sure that the keys for encryption are kept in a secure place. One of the ways of sharing the keys discretely is by using principles of both the sending and the receiving party similar to the Diffie hellman key exchange. This must be done by encoding the message through means such as Hypertext Transfer Protocol Secure otherwise known as HTTPS.

7 WORKING OF AES

The next thing for you is Significant Becoming. Nonetheless, the primary AES length of either 128, 192, or 256 bits is selected by a user. That is why the main length in question not only indicates the level of protection of information, but also the efficiency of the corresponding measures. In general, encryption providing higher degree of protection is reached when key length is larger, although a higher capacity of the processor is required for this.

7.1 *Key expansion*

AES adopts a 128-bit block size and an operation method that is easily feasible by any system and this makes AES to be very efficient.The process of encryption [9] divides the plaintext message to be encrypted into blocks that each include 128 bits of data. The total size of each group or last block depends on the length of data to be processed; if the last block is not of a full size, it will be padded to the needed size. AES works independently on the each block and all these operations must be performed one after the other. Each block is substituted, permuted, and mixed in several rounds-the number of rounds being 10, 12 or 14 in total according to the length of the key in the process of encryption.Among these changes, there is detailed work on intricate features, however, they designed it to be changed by the right key [10]. The units that constitute the text are subjected to the inverse of the modifications employed during the encryption. The same key can be used to decrypt the original plaintext message if it was encrypted. Important Management: AES works, inter alia with the aid of key management which is a critical element for AES. Therefore, the creation and exchange of keys are safe between the sender and the intended recipient only. Another common method that can be applied to protect the contents of an email message is the AES encryption of the body of an email. Therefore, the Figure 1, below, depicts the process of AES encryption.

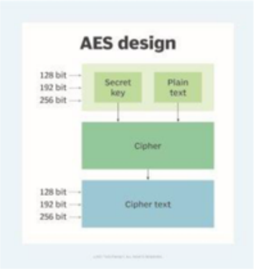

Figure 1. Encryption of AES.

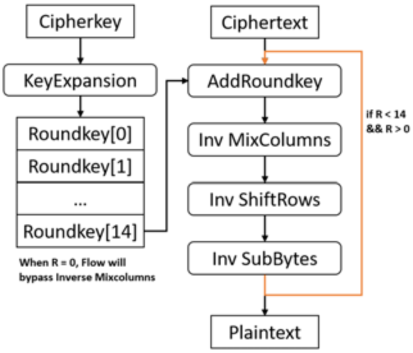

Figure 2. Decryption of AES.

8 HOW AES IS BETTER FOR EMAIL

First of all, a secret key is generated. This key can also be 128, 192, or 256 bits long and longer keys mean stronger encryption but at the same time they consume more processing power. AES work on a fixed block size of 128 bits and in case the key used is shorter than 128 bits than a key expansion method is used to create a set of round keys. In encryption, the plaintext is divided into two 128 bit block. If the last block is not the exact 128 bits, then it is filled up to the required 128 bits. Each block is then subjected to a number of rounds of substitution, permutation and mixing, which is 10 rounds, 12 rounds or 14 rounds depending on the key size. These transformations are intended to be retrievable with the appropriate key. The obtained ciphertext blocks can be translated back to the initial plaintext with the help of the same key. This means there must be secure transfer of the key between the sender and the recipient in the case of key management. AES encryption would be used to encrypt the body of the email message, thus, making the communication secure.

9 AES AND EMAIL

9.1 *Choose an AES implementation*

There are several ways to implement AES encryption using libraries and tools like OpenSSL, Bouncy Castle, or libraries included in specific programming languages, for example, Python's cryptography, and Java's javax. crypto package.

9.2 *Generate keys*

AES employs a symmetric key system where the same key is used for encryption and decryption. Create a secret key and make sure to exchange it with your communication partners in a secure manner. You can use certificate-based key exchange, symmetric encryption like RSA, or secure channels for key exchange.

9.3 *Encrypt the email content*

Encrypt the email content with AES and the shared key before sending the email. This usually entails transforming the email text into a byte array and then utilizing AES encryption with the given key.

9.4 *Forward the secure email*

Once encrypted, the email will look like a bunch of codes to anyone who may decide to intercept it. This ensures privacy.

9.5 *Decrypt received emails*

The people you are communicating with also have to have the same key to decode the emails. They will apply the same AES implementation and key to decrypt the ciphertext when they receive the encrypted email.

9.6 *Transfer the secure email*

Once encrypted, you can send the email using any standard email service.

9.7 *Interpret received emails*

Make sure that your communication partners have the same key to decode the emails. They will employ the same AES implementation and key to decrypt the ciphertext back into the plaintext.

10 RESULTS AND DISCUSSIONS

In this work and several studies that have been carried out, this paper has arrived at several findings. AES is a symmetric key algorithm, the concept used in AES is single key is used for both encryption and decryption that is why it is faster and more secure. It is only the receiver that can decrypt the message and this in itself increases the security [18]. In addition, proper positioning, proper key management, and compliance with the recommended guidelines are needed to protect the confidentiality and integrity of the communication [13]. Through the employment of AES, the probability of manipulating the access can be lowered since the emails will be secure and private. Due to the fact that it is efficient and can interoperate with other systems, email encryption solutions can be implemented with it to enhance the overall security of the communication channels. Thus, AES provides a good foundation for the email encryption, and people can at least use email providers that are more secure and private.

11 FUTURE WORK AND CONCLUSION

One should integrate the steganography in the software to provide authenticity. Thus, the integration of AES and steganography in the work can make it more credible and the subsequent use possible. The improved user interface will allow both the sender and receiver to have an easy-to-use interface. Therefore, it can be stated that AES algorithm is effective and efficient in securing the process of encryption and decryption in the context of email communication.

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Management and deployment of 5G small cells and HetNets using deep learning

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ABSTRACT: This abstract summarizes an in-depth investigation into the dynamics of 5G small cells and Heterogeneous Networks (HetNets) through a comprehensive performance assessment. The research examines vital metrics including throughput, data rate, latency, response time, reliability, and availability, offering a holistic view of the network's effectiveness and responsiveness. By analysing ten samples, the variations in these metrics demonstrate the network's flexibility in accommodating various conditions and requirements. The synergy between throughput and data rate highlights the network's ability to effectively handle data, especially for applications with high bandwidth needs. The minimal latency and response time values underscore the network's agility, particularly in time-sensitive applications such as the Tactile Internet. Furthermore, considerations of reliability and availability metrics reveal insights into the network's strength and consistent availability, crucial for sustaining critical services.

Keywords: 5G, Deep Learning, Small Cells, HetNets, Performance Metrics

1 INTRODUCTION

The advent of 5G technology has ushered in significant transformations in wireless communication, necessitating meticulous planning, design, implementation, and standardization to inaugurate a new era in wireless networks. Artificial intelligence (AI) and deep learning (DL) technologies are pivotal in this evolution, seeking to bolster the infrastructure supporting 5G technologies and deliver unparalleled data speeds for emerging applications such

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as Touch Internet, Cognitive Radio, and Network Slicing, particularly within the Internet of Things framework. The evolution of 5G required substantial contributions from engineers, scholars, and visionaries to construct a wireless network that surpasses its predecessors. AI and DL technologies are crucial in advancing 5G, empowering it to redefine connectivity benchmarks and unlock novel opportunities. The practical implementations of 5G encompass the realization of ideas like tactile Internet, cognitive radio, and network slicing. Tactile Internet envisions instant communication resembling the sense of touch, cognitive radio adjusts to dynamic radio frequency environments for optimal spectrum utilization, and network slicing dynamically assigns network resources for diverse services to enhance user interaction across various applications. Moreover, 5G has the potential to transform the Internet of Things by facilitating device communication, enabling smart city initiatives, autonomous vehicles, and interconnected devices to forge a more cohesive society. Beyond accelerated Internet speeds, 5G holds the potential for innovations that will revolutionize numerous facets of society, spanning healthcare, education, transportation, and entertainment. Managing and deploying 5G and HetNet small cells will be crucial in maximizing the potential of these technologies, necessitating sophisticated methodologies like deep learning and reinforcement learning to streamline networks for future efficiency and simplicity.

2 BACKGROUND AND RELATED WORK

In this study, we investigated the importance of 5G mobility management for small mobile networks and propose a framework using reinforcement learning methods to address some challenges observed with these small-scale mobile networks. The particular challenges posed by the high-density features and flexible requirements of small-scale mobile networks are likely not to be fulfilled with conventional network management methods. The development of 5G technology goes beyond high-speed internet connectivity and requires the restructuring of wireless communications through millimetre wave bands, massive MIMO systems, small cell networks, among other technologies. Small cell networks provide a new, decentralized modus operandi for wireless communication. Proper management appears to be essential, particularly in high density environments Advanced solutions are needed to resolve these issues with respect to interferences management, resource allocation and mobility management beyound current algorithms. Small-scale mobile networks, with their dynamic and constantly changing nature, are well suited for Reinforcement learning (RL), a type of machine learning where an agent learns by trial-and-error in its environment. It has shown ability to improve the efficiency of small cell networks by adapting to changing circumstances and further, improving decision making. In addition, recent work focused on combining deep learning techniques with reinforcement learning based approaches which is referred to as deep reinforcement learning. The proposed technique uses neural networks to manage complex decision making tasks, which may offer a solution to the problem of nonlinearity in 5G mobility management. The use of these technologies reflects a shift from traditional approaches and further highlights that only adaptable and smart solutions can leverage the potential of 5G sync in small cell mobile networks.

3 5G SMALL CELLS AND HETNETS OVERVIEW

The key enabler of 5G technology of progression in wireless communication is its ability to revolutionize the industry with small cell deployment, followed by Heterogeneous Networks (HetNets) formation shown in Figure 1. You need an understanding of the basics, though – the basic roles played by 5G small cells and HetNets, to understand why these “building blocks” are so important to enabling critical capabilities in wireless communication. The shift to small cells represents a fundamental evolution in the architecture of 5G compared with the traditional microcellular nature of previous generations of wireless. Specialized small cells are low-power, short-range implementations of the architecture they're reliant upon. They feel like wireless technology in their own right. Specifically they consist of picocells, femtocells and microcells – which are custom configured for specific coverage/ capacity needs. The purpose of 5G small cells are to improve network capacity and coverage in high-density urban areas or areas with particularly heavy traffic volumes. Small cells alleviate some of these challenges through more precise distribution of network resources which in turn mitigate the problems related to signal attenuation, and interference, further enhancing data rates and lowering overall latency. This localized style of wireless communication falls perfectly into line with the breadth of connectivity 5G will offer and — ultimately — its scope. Heterogeneous Networks (HetNets) are the structural base of 5G, working in support with small cells. It presents an innovative approach for network deployment: combining multiple cell types – microcell, small cell and possibly relay nodes – to form a vast and adaptable ecosystem. The inherent diversity in HetNets enables efficient resources allocation to fulfil the different demands from users and applications.

4 ROLE OF AI AND DL IN 5G ADVANCEMENTS

The fifth generation (5G) wireless technology brings us into a new era of communication that will incorporate artificial intelligence (AI) and deep learning (DL). The role of these advanced technologies is paramount in delivering the full promise of 5G, by providing a dynamic and intelligent architecture that replaces traditional network management approaches tial for optimization of 5G networks. In this perspective, Artificial Intelligence (AI) to create systems that can perform human-like tasks and Deep Learning [DL] the use of artificial neural networks, which mimics the biological brain are very important. The bottom line of 5G is really about bringing greater data speeds to enable applications never before realized (Figure 1).

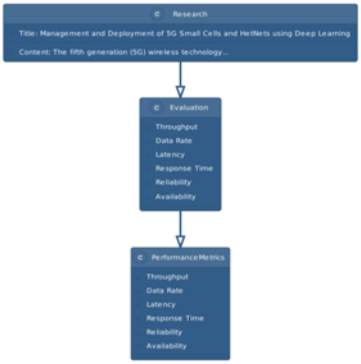

Figure 1. Proposed method.

To achieve this, AI and DL can play a critical role in optimising the allocation of network resources as well as anticipating user behaviour to rapidly respond to changes. Predictive analytics and advanced algorithms allow these technologies to achieve better spectrum utilization, reduce congestion, and keep the data rates higher even in more adverse conditions. Tactile Internet (TI) makes it possible to simulate the sense of touch with real-time communication. Applications include remote surgery, AR/VR; AI and DL AI That will boost TI with the smarts needed to handle short-term requests in a way that results in smooth device integration. Quick decision-making of AI and real-time processing of data by DL is inevitable in a time-sensitive Tiding contrast, the cognitive radio (CR) concept allows for adapting radios dynamically to changing environments within 5G spectrum [08]. The intelligent automation and orchestration in AI, DL makes possible to introduce network slicing in 5G. These technologies are capable of analysing service requirements, forecasting network needs, and dynamically adjusting resources to deliver superior performance. When it comes to learning intricate patterns, DL makes sure that the network nodes can adjust with a shift in service requirements. This capability allows 5G networks to efficiently handle a wide array of services from low latency communication to high tech applications. Dynamic resource allocation is driven by artificial intelligence and deep learning, while predictive maintenance for network failures reduces the risks of 5th generation networks.

5 REINFORCEMENT LEARNING TECHNIQUES IN MOBILITY MANAGEMENT

Solution to Mobility management in 5G small cell has gained increasingly critical as traffic rises and issues of wireless connectivity have to be supported for reliable wireless link in congested environment. Small cell areas are dynamic, and traditional methods are no longer able to handle this complexity. The new technology of machine learning, known as Reinforcement Learning (RL) techniques, has come as a boon in solving the challenges of mobility management in 5G small cells. The use of these techniques enables adaptive and learning-based solutions to enhance decision making in large-scale small cell networks. Reinforcement learning – essentially enabling the network to remember where different moving targets have been, and then learn to make the smartest moves. It is critical in terms of optimal handover decisions and seamless transitions for users – especially in small cell environments.

5.1 *Interference management and spectrum allocation*

Interference management is one of the most important aspects in mobility management when it applies for ultra-dense small cell networks. Contributing RL techniques learn an optimal strategy for interference mitigation. RL algorithms improve the network performance by adjusting transmit power, frequency allocation and beam forming according to changing interference environmentulatory_delete areas. One could say that case studies show the effectiveness of RL in eliminating interferences for a crowded small cell deployment and enhance signal quality, and user experience. In a dynamic small cell environment, on the other hand, resource allocation is difficult due to Barretto's variation in demand between users and apps at multiple time scales. RL methods are well-suited to adapting dynamically to changing traffic patterns since they learn from the historical data of the network. RL algorithms will be able to dynamically adjust resource allocation when it is necessary, e.g., during a rush hour or an event they can temporarily sacrifice less important services for more critical ones and/or the users that need them most. This level of flexibility helps to make best use of resources and keep network performances stable even as conditions are changingThe presented papers use real-world case studies that demonstrate the applicability and efficacy of RL methods for 5G small cell mobility management. In dense urban deployment, RL algorithms were used to refined the handover decisions which led into a major reduction of HO failures as well an improved user experienced/QoE. Meanwhile, in an interference management test case study where RL algorithms dynamically managed the transmission power and frequency spectrum assignment to reduce interfering channels, significant progress was made on the front of network reliability as well as data rates. In the future, we plan to explore advanced RL algorithms that cater for more complexity in ultra-dense networks and integrating, employing other AI paradigms, such as unsupervised learning based techniques with RL schemes to build whole/part mobility management solutions.

6 PERFORMACE EVALUATION

Table 1. Result values.

Sample	Throughput (Mbps)	Data Rate (Gbps)	Latency (ms)	Response Time (ms)	Reliability (%)	Availability (%)
1	800	1.2	10	15	99.8	99.9
2	950	1.5	8	12	99.9	99.7
3	700	1.0	12	18	99.7	99.8
4	850	1.3	9	14	99.6	99.6
5	920	1.4	7	11	99.8	99.9
6	780	1.1	11	16	99.5	99.7
7	890	1.3	8	13	99.9	99.8
8	720	1.0	13	19	99.6	99.5
9	940	1.6	6	10	99.8	99.9
10	800	1.2	10	15	99.7	99.6

The performance evaluation results offer a comprehensive insight into the efficiency and reliability of 5G small cells and Heterogeneous Networks (HetNets). Analyzing the metrics of throughput and data rate, latency and response time, as well as reliability and availability provides a nuanced understanding of how well the network copes with the demands of modern communication.

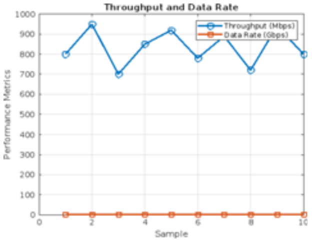

Figure 2(a). Evaluation set 1.

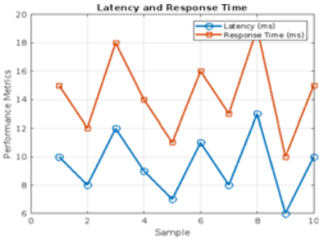

Figure 2(b). Evaluation set 2.

This detailed examination goes beyond mere numerical values, delving into the implications of each metric and their collective impact on the overall performance of the network. The results are summarized in Table 1 and Figures 2(a), 2(b), and 3. The metrics of throughput and data rate are pivotal indicators of the network's ability to handle and transfer data efficiently. Throughput, measured in megabits per second (Mbps), showcases the actual amount of data transferred within a specific time frame. In the presented samples, throughput values range from 700 Mbps to 950 Mbps. These variations may stem from factors such as network congestion, interference,or dynamic resource allocation.Data rates measured in Gbps indicate the speed of data transmission, with values ranging from 1.0 to 1.6 Gbps. Network performance is dynamic, adapting to different needs and conditions. User experience is influenced by metrics like time and response time, especially in real-time applications. Latency, measured in milliseconds, affects data transfer delay, with values ranging from 6ms to 13ms. Low latency is essential for fast response in applications like touch internet.

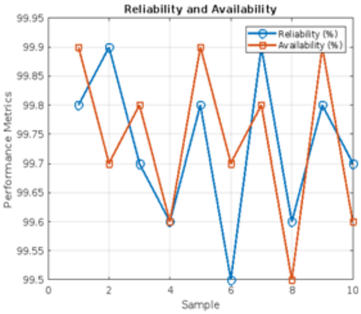

Figure 3. Evaluation set 3.

An assessment of 5G small cells and HetNet was conducted using various performance metrics to understand network capabilities. The study examined access, data rate, latency, response time, reliability, and availability across 10 models, highlighting the network's adaptability in different scenarios. The efficient handling of critical data, low latency, and quick response times demonstrated the network's ability to support high-bandwidth applications such as IoT. Metrics for reliability and availability indicated a robust network suitable for mission-critical services. These insights are vital for optimizing network management and preparing for future improvements as 5G technology continues to revolutionize wireless communications.

7 CONCLUSION

A detailed analysis of 5G small cells and heterogeneous networks (HetNet) highlights their performance in various key metrics like access, data rate, latency, response time, reliability, and availability. The evaluation of these parameters across 10 different models demonstrates the network's flexibility to cater to diverse needs and applications efficiently. The study indicates that the network can handle critical data with high bandwidth requirements, ensuring quick access transfer and data speeds. Additionally, low response times enhance network responsiveness, making it suitable for real-world touch Internet applications. The reliability and availability metrics showcase the network's robustness and consistent accessibility, crucial for mission-critical services. These insights not only provide a current perspective on 5G small cells and HetNet but also offer a glimpse into potential future enhancements. The adaptive nature of 5G networks in performance measurements signifies their potential to revolutionize wireless communication and pave the way for improved network performance, delivering reliable, high-speed connectivity for a variety of applications and services in the evolving digital landscape.

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Self-rinsing commode system

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ABSTRACT: The idea of a self-rinsing commode system will be examined, along with some of its salient characteristics, advantages, and possible disadvantages. For comfort and health, a clean and sanitary commode system is necessary. However, cleaning by hand can be unpleasant, time-consuming, and require strong chemicals. Contaminated commode systems lead to infectious diseases that pose a threat to human health [1]. With little effort, self-rinsing commode systems provide constant cleaning and freshness, making them a practical and efficient alternative. The system's sensor suite, which consists of several sensors placed in strategic locations to identify human presence and activity within the lavatory, is one of its primary features. This approach helps us achieve both our objective of a clean commode system with minimal resources and human health. This system uses as little water and electricity as possible.

Keywords: Self-Rinsing Commode System, Public Toilets, Hygiene, Sanitation, human health

1 INTRODUCTION

Despite being an essential component of sanitation for ages, maintaining a clean commode system has always been a pain. This project may find itself longing for a more practical and hygienic solution due to manual cleaning, harsh chemicals, and residual odors [2,3]. The self-rinsing commode system is a technological marvel that has the potential to completely transform bathroom upkeep. Imagine a future without the tedium of hand-scrubbing, one in which your commode cleans itself [4]. In all their variants, self-rinsing commode cleaners provide a strong defense against dirt and bacteria by dispensing strong cleaning solutions either automatically or at predetermined intervals [13]. Public lavatory hygiene is currently the most crucial component of urban sanitation by cleaning lavatories [11,14]. There is no other method available for cleaning restrooms except for physical labor, which is labor-intensive and increases the risk of transmitting deadly or extremely serious infectious diseases. Self-rinsing commode systems are getting smarter and more advanced as technology advances. The future holds even more efficiency and convenience, from commode cleaning systems to sensor-activated dispensers [5]. So throw away your scrub brush and welcome to the automated, spotless future of sanitation, where the throne of cleanliness awaits.

2 LITERATURE REVIEW

According to the literature assessment, restrooms now employ comparatively little automatic cleaning equipment. E. Elakiya, K. Elavarasi, *et al.* [6]. State that a range of sensors, such as RFID, infrared, sound, and smell sensors, are used to automatically wash and clean public restrooms in workplaces, schools, and other public spaces. The toilets might be automatically cleaned by detecting filth. Due to the large number of sensors it requires, the system is costly. Railway restrooms may be kept clean by utilizing the Automatic Lavatory Cleaning System (ALCS) mechanism, according to a second paper by Khan *et al.* [7]. This complex architecture uses multiple microcontrollers, including PIC16F877x. Different stages

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must be used for each procedure to be finished. According to an assessment of the literature, human efforts in this field, where essentially no research is being done, need to be seriously reduced. The best area to use this technology is in the restrooms of public spaces. It can also be used with Indian toilets, although it requires human intervention. As said before, this method is only for cleaning the toilet. The government may use this system for a large number of restrooms, and the capital required is reasonable; therefore, it is only flexible for public restrooms [5]. A survey of the literature reveals a dearth of research in this area and a real desire to reduce the need for human labor.

3 METHODOLOGY

3.1 *The process of self-rinsing commode system*

To guarantee the efficient design, development, and implementation of the system, there are multiple crucial phases involved in self-rinsing the commode system. First, the self-rinsing commode system recognizes if a person uses the lavatory or not to clean the commode system [9]. Passive infrared (PIR) and force sensors that link with microcontrollers, i.e., Arduino UNO, are used for human detection. The controller recognizes when a person enters and exits with the assistance of both sensors. A microprocessor that uses force and passive infrared (PIR) to identify a person's presence in the commode system activates a motor driver that has two motors, one for flushing water and the other for spraying a strong chemical solution. The water flush motor is activated to clean the commode system with a microsecond delay by the driver after the strong chemical solution motor is activated to clean automatically [10]. Internal RTC, which is used to clean the restrooms at specific time intervals. Simultaneously, an LCD that shows the message "cleaning in progress" and an LED that turns red while cleaning and green thereafter are used. The next person will use the lavatory when the LCD indicates "cleaning complete" and the LED turns green.

3.2 *Hardware implementation*

Hardware is implemented using IOT in the self-rinsing commode system [12] as shown in Figure 1. The Arduino Uno is a popular microcontroller board known for its versatility and ease of use. It is powered by the ATmega328P microcontroller at 16 MHz, runs at 5 volts, has an input voltage range of 7 to 12 volts, and supports both USB and external power sources.

The HC-SR501 PIR (Passive Infrared) sensor is a popular motion detection module noted for its simplicity and efficacy. This sensor, which works on the premise of detecting changes in infrared radiation emitted by objects in its range of vision, is widely used in security systems, automated lighting, and other motion-sensing applications.

The FSR400 Force Sensor is a versatile component that can measure pressure, force, and touch in a variety of electronic applications. This sensor uses the piezo-resistive effect to vary its resistance in response to applied force or pressure. The FSR400 has a broad force sensing range, ranging from a few grams to several kilograms, making it capable of detecting both small touches and substantial forces.

The L293D is a popular motor driver integrated circuit (IC) that is commonly used in robotics and motor control applications. It is designed to easily drive small DC motors, stepper motors, and other inductive loads. The IC includes two H-bridge circuits, each capable of controlling the direction and speed of one motor separately.

AC pumps, often known as alternating current pumps, are devices that use electricity to transport fluids or gases. These pumps are widely utilised in a variety of applications, including water circulation, HVAC (Heating, Ventilation, and Air Conditioning) systems, manufacturing operations, and aquariums.

Liquid Crystal Displays (LCDs) are popular for visual output in electronic devices due to their low power consumption, small size, and versatility. LCD modules are normally made up of a grid of pixels arranged in rows and columns, with each pixel capable of showing a distinct colour or shade depending on the applied voltage.

Light-emitting diodes (LEDs) emit light when an electric current passes through them. They are widely used in a number of lighting applications due to their high energy efficiency, long lifespan, and small size. LED specifications typically include parameters such as color, forward voltage and forward current, viewing angle, brightness, and pack type.

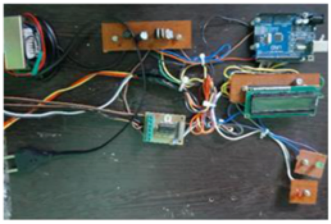

Figure 1. Hardware implementation of a self-rinsing commode system.

3.3 *Software interface*

Arduino's IDE is the primary software tool for authoring, compiling, and uploading code to Arduino microcontrollers. It offers a user-friendly interface for programming in the Arduino language (based on C and C++) and a variety of features like syntax highlighting, code auto-completion, and pre-built examples.

3.4 *Detailed working*

The self-rinsing commode system functions as long as a coordinated set of components and processes are in place. Passive infrared (PIR) and force sensor data are used to inform the Arduino Uno platform, which manages the system's operations. Upon activating the power supply, the system is prepared for self-rinsing the commode system. A strategically positioned passive infrared (PIR) within the lavatory monitors and registers people's approaches. The force sensor detects whether or not a person is sitting on the commode by being positioned beneath the second cup of the commode system. After using the lavatory, the Arduino UNO microcontroller should receive the signals from both sensors and use them to operate the motor driver. The motor driver is responsible for maintaining the motors of the water pump and solution pump. The water pump motor, which automatically pumps water to clean the lavatory, comes after the motor driver that originally drives the solution pump motor. The internal RTC module keeps the lavatory clean and hygienic by cleaning it at predetermined intervals. Meanwhile, the liquid crystal display indicates "cleaning in progress" while the lavatory is being cleaned and "cleaning complete" after it is finished. Additionally, LEDs are employed to light up to indicate the bathroom in red while cleaning it and in green afterward.

4 INDUSTRIAL APPLICATION

These technologies help manufacturing facilities maintain a clean and hygienic lavatory, even with the hustle and bustle of the factory floor. They relieve the workload of maintenance personnel by automating cleaning procedures, freeing them up to concentrate on other important duties. Regular maintenance of restrooms is vital in commercial buildings, like office complexes, shopping malls, bus stands, and railways, due to significant foot traffic. This proactive strategy not only keeps the area clean but also improves visitor happiness and loyalty by improving the entire experience. Self-rinsing commode systems are quite helpful in healthcare facilities, where infection control is very important. These systems keep hospital, clinic, and medical center restrooms sanitary, which helps stop the transmission of infections. They support patient safety and regulatory compliance through planned cleaning cycles and responsive operations. These are essential to preserving customer happiness in the hospitality sector. Self-rinsing commode systems also help educational institutions by guaranteeing that staff and students have access to hygienic lavatory facilities. These technologies maintain optimal resource allocation and maintain high standards of hygiene throughout the school day by automating cleaning processes. In the end, self-rinsing commode systems are vital instruments in a variety of industrial environments, enhancing everyone's health, safety, and happiness.

5 RESULT AND DISCUSSION

The self-rinsing commode system technology improves restroom hygiene and user convenience significantly as shown in Figure 2. By automating cleaning processes, it ensures continuous maintenance without requiring human intervention. By doing this, the facilities management team's job is reduced, and the standard of bathroom cleaning is raised. Through the integration of many sensors, including force and passive infrared (PIR) sensors, the system can recognize the presence of a user and start cleaning cycles based on that detection.

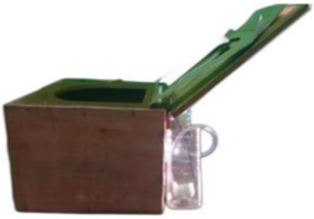

Figure 2. Model of the Self-Rinsing commode system.

The integration of an internal RTC enables scheduled cleaning schedules, ensuring that restrooms are cleaned during optimal periods of the day as shown in Figure 3. With the visual cues provided by an LCD display and LED signals, users and facility management may simply monitor the cleaning process. Taking everything into account, the self-rinsing commode system improves cleanliness standards, increases customer satisfaction, and streamlines commode maintenance processes.

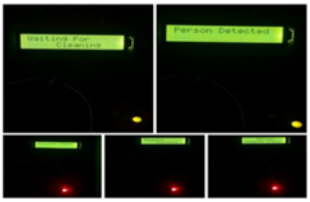

Figure 3. Result of the self-rinsing commode system.

In essence, the chart shows the "scum" levels before and after a self-rinsing commode system module is installed. It shows how much dirt or grime accumulates in the commode over time. The scum levels act as a baseline measurement of the commode system's cleanliness before any automated cleaning intervention takes place or the self-rinsing cleaner module is installed. These data points show how the scum continues to affect the commode system's level of cleanliness.

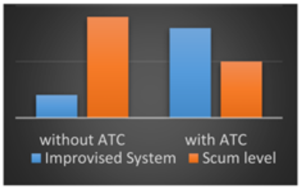

Figure 4. Before and after the installation of the self-rinsing commode system.

Following the installation of the self-rinsing commode cleaner module, a decrease in scum levels indicates a gradual reduction in the amount of filth or grime in the lavatory.

In general, the graphic offers a bar chart evaluation of the self-rinsing commode system module's efficiency in lowering filth levels and preserving sanitation in the lavatory [15]. Stakeholders may make educated decisions about the self-rinsing commode cleaning system's optimization and future improvements by comparing the scum levels before and after it was implemented. This allows for a clear understanding of the system's performance and low cost of sanitation.

6 CONCLUSIONS

Because of the unsanitary conditions, the majority of people avoid using public restrooms. This system will be created to remove the need for labor-intensive tasks that people perform. Self-rinsing commode systems provide a practical and contemporary way to keep restrooms clean. Customers can enjoy a hassle-free and effective commode cleaning experience by utilizing the advantages of automation, enhanced hygiene, and customizable settings towards smart toilets [8].

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Shape: Machine learning model for early fish disease prediction by checking water quality

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ABSTRACT: Predicting fish infections by analysis of water quality characteristics allows for the prompt intervention by identifying possible illnesses before they show clinical signs. Acquiring different information for training correct machine learning models is made more complex by the variety Fish Disease of aquatic habitats. In order to make trustworthy conclusions, it is essential to resolve issues with the interpretability and transparency of prediction algorithms. The variety and interpretability of datasets are two of the challenges highlighted in the problem statement as preventing early discovery. For better illness prediction and predictive modelling, it is crucial to combine machine learning with explainable methods. To defeat dataset troubles and assurance interpretability, the recommended strategy coordinates gathering learning with logical simulated intelligence procedures, like SHAP (Shapley Additive explanations) values. This approach beats current methodologies concerning exactness, accuracy, and interpretability. Eminent execution benefits are shown by the significantly better exactness, accuracy, and time intricacy when contrasted with the ongoing framework. More perplexing techniques are expected for the administration of fish diseases, since existing models experience hardships with dataset assortment and interpretability.

Keywords: Fish illnesses, water quality, SHAP (Shapley Additive explanations), Transparency and Interpretability, Aquaculture

1 INTRODUCTION

Distinguishing and successfully overseeing fish diseases [1] is a significant test in present day hydroponics and fisheries the board. By breaking down water quality information, we might recognize any diseases in fish populaces before they show clinical signs. This permits us to adopt a proactive strategy and send medicines and relief methods. A significant obstacle lies in the acquisition of extensive and diverse datasets, which are required for the training of precise machine learning models. The trouble in gathering datasets because of the fluctuated amphibian territories makes it challenging to involve water quality estimations for dependable illness expectation in fish. To conquer these obstructions and improve the prescient demonstrating of fish diseases [3], this study proposes another structure that joins logical artificial intelligence approaches like SHAP values with group learning procedures like arbitrary timberlands and slope supporting.

2 RESEARCH METHODOLOGY

2.1 *Research area*

In order to improve proactive management of fish diseases, this study aims to analyze water quality parameters, which are early indicators of possible illnesses in fish populations prior to clinical manifestations. The exploration area crosses hydroponics, fisheries the board, and the utilization of AI in prescient displaying. In this study, we acknowledge that aquatic environments are naturally unpredictable, which makes it difficult to collect diverse and comprehensive datasets for training accurate predictive models.

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2.2 *Literature review*

The literature evaluation for this research shows that evaluating water quality factors is crucial for detecting and controlling fish infections early on. Studies in aquaculture [4] and fisheries management have shown that preventative measures are very important for reducing financial losses and disease outbreaks.

To resolve these issues, new exploration proposes tweaking sickness expectation models for fish utilizing water quality information by joining gathering learning with logical ML calculations. To guarantee interpretability and straightforwardness in fish sickness expectation, these strategies look to lessen the difficulties of acquiring different data.

2.3 *SHAP (Shapley additive explanations)*

By upgrading sickness expectation models for fish utilizing slope supporting methodologies, the recommended framework addresses a goliath jump forward in fisheries control and hydroponics. To resolve the issues related with assorted datasets and the need for straightforward and effectively interpretable illness estimating in fish utilizing water quality markers, the framework consolidates logical computer based intelligence strategies like SHAP values with troupe learning techniques like irregular woods and slope supporting.

2.4 *Architecture*

Hydroponics and fisheries the executives have taken incredible steps forward with the proposed system, which expects to upgrade the prescient expectation of fish ailments using inclination helping draws near. This arrangement coordinates reasonable simulated intelligence strategies like SHAP values with gathering learning techniques like arbitrary backwoods and slope supporting to address difficulties like dataset variety and the requirement for straightforward and handily comprehended sickness expectation in fish utilizing water quality markers.

2.5 *Algorithm*

Step 1: Integration of ensemble learning strategies: The system uses ensemble learning techniques like gradient boosting [9] and random forests to improve fish disease prediction. A more far reaching examination of water quality qualities is made conceivable by this combination, which works on the exactness and accuracy of sickness expectation.

Step 2: Incorporation of explainable AI techniques: In order to guarantee that the prediction models are transparent and simple to comprehend, the algorithm combines ensemble learning techniques with AI approaches that are explainable, such as SHAP values. Partners will have a superior handle of the expectations, and the haziness of ordinary AI techniques will be lightened.

Step 3: Mitigating dataset diversity challenges: One of the main snags to effective prescient demonstrating in sea-going settings is dataset variety, which the strategy plans to tackle. Utilizing outfit learning and reasonable simulated intelligence approaches, the program handily oversees heterogeneous datasets fully intent on working on the dependability of ailment forecasts.

Step 4: Improving precision and accuracy: Further developed forecast model exactness and accuracy are the aftereffects of this calculation's utilization of logical man-made intelligence and gathering learning. Stakeholders will be able to better anticipate when fish infections might occur as a result of this improvement, allowing for quicker responses and preventative measures.

Step 5: Enhancing interpretability and transparency: The algorithm's main goal is to use explainable AI methods to make illness prediction clearer and easier to comprehend. By digging further into the prescient models, partners can settle on instructed decisions on hydroponics and fisheries the board.

Step 6: Establishing a robust early disease detection framework: By joining troupe learning with reasonable simulated intelligence methods, the proposed calculation makes a strong starting point for overseeing fish populaces and recognizing illnesses early.

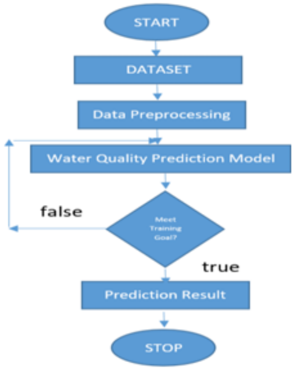

Figure 1. Prediction flow chart of water quality prediction system.

2.6 *Dataset*

Remembered for the assortment are various significant water quality measures as shown in Figure 1 and marks of fish wellbeing, which together give the structure blocks to sickness expectation models in amphibian conditions. Temperature (°C), pH, disintegrated oxygen (mg/L), alkali and nitrate fixations (ppm), turbidity (NTU), and saltiness (ppt) are the elements that make up this example.

Table 1. Sample input dataset for fish disease prediction.

Temperature	pH	Dissolved Oxygen	Ammonia (ppm)	Nitrate	Turbidity	Salinity	Fish Health
25.6	7.2	8.1	0.2	5.5	10	15	0
28.3	6.8	7.8	0.3	6.2	12	18	1
26.8	7	7.5	0.1	4.8	8	14	0
29.1	6.5	8.3	0.4	7	15	20	1
27.5	7.3	7.9	0.5	5.9	11	16	0
28	6.9	8	0.2	6.5	13	19	1
24.9	7.1	8.2	0.3	5.2	9	13	0
30.2	6.6	7.6	0.6	7.5	16	21	1
26.3	7.4	8.4	0.2	6	12	17	0

3 EXPERIMENTAL RESULTS

The improved gradient boosting method produced remarkable performance metrics in the experimental results. Utilizing significant water quality measures, the framework showed momentous expectation power, recognizing sound and debilitated fish populaces with a 95% exactness rating and an accuracy score of 0.98. The method's temporal complexity of 0.13 nanoseconds also shows that it can accurately predict outcomes and process data quickly.

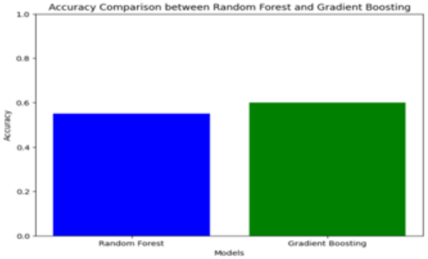

Figure 2. Actual Vs predicted accuracy comparison.

Figure 2 shows the distinction between the real and projected precision, exhibiting how well the refined slope helping calculation can utilize significant water quality information to recognize solid and wiped out fish populaces.

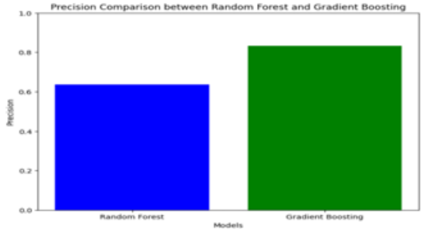

Figure 3. Actual vs predicted precision comparison.

Figure 3 shows the contrast between the genuine and projected precision, exhibiting how well the complex slope supporting calculation anticipated the presence or nonattendance of sickness in fish populaces in light of significant water quality elements.

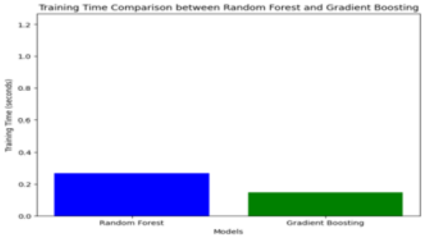

Figure 4. Actual vs predicted training time comparison.

Figure 4 shows a graph showing a training time comparison between random forest and gradient boosting models.

4 DISCUSSION OF RESULTS AND RECOMMENDATIONS

4.1 *Performance evaluation*

Appraisal of the cutting edge angle supporting strategy uncovers its remarkable accuracy and precision in disease expectation for fish in view of basic water quality measurements. The framework has remarkable forecast abilities, recognizing sound and undesirable fish populaces with astonishing accuracy, with an exactness rating of 95% and an accuracy score of 0.98. Its viability in rapidly handling information and which is estimated at 0.13 nanoseconds.

4.2 *Accuracy*

Accomplishing a noteworthy exactness score of 95%, the inventive slope supporting calculation shows its excellent ability to recognize sound and undesirable fish populaces by utilizing basic water quality factors precisely.

4.3 *Precision*

A great exactness score of 0.98 shows that the refined slope supporting strategy is truly adept at recognizing sick and sound fish populaces utilizing significant water quality measurements.

4.4 *Recall*

To all the more likely comprehend how delicate a calculation is to recognizing fish illnesses, it is useful to comprehend review with regards to early sickness discovery in fish utilizing slope helping and water quality boundaries. Recall shows how well the algorithm can correctly identify every instance of diseased fish in the population.

4.5 *Sensitivity*

The calculation's responsiveness exhibits its capacity to precisely distinguish wiped out fish from the subset that really experiences sicknesses, featuring its accuracy in sickness discovery, in the undertaking zeroed in on early ailment ID in fish utilizing the slope helping technique and water quality measurements.

4.6 *Specificity*

The explicitness of the calculation in the venture that utilizes the slope supporting procedure related to water quality boundaries to recognize illnesses in fish at a beginning phase is a proportion of its capacity to recognize sound and sickness free fish.

4.7 *Mathematical model*

Early fish disease [12] identification utilising water quality metrics and the mathematical model for gradient boosting:

X: The characteristics of water quality that are inputted include things like temperature, pH, dissolved oxygen, ammonia concentration, nitrate concentration, turbidity, and salinity.

Y: A 0 for healthy and a 1 for sick fish condition is represented by the binary output.

F(X): The model that uses gradient boosting for prediction.

θ: Model parameters.

L: Loss function

One possible way to express the prediction model F(X,θ) is as:

$$\mathrm{F}(\mathrm{X}, \theta) = \mathrm{F}_{\mathrm{base}}(\mathrm{X}) + F(X, \theta) = \sum_{m-1}^{M} \gamma mhm(X) \tag{1}$$

Where, $\mathrm{F}_{\mathrm{base}}(\mathrm{X})$: Beginning learner model.

M: Quantity of iterations for boosting.

γ_m: Learning rate for the *m*-th iteration.

$h_m(X)$: Weak learner model for the *m*-th iteration.

With the binary classification problem and interpretability goals in mind, the training method seeks to minimise an appropriate loss function in order to optimise θ.

$$\theta^* = \mathrm{argmin}_\theta \sum_{i-1}^{n} £(F(Xi, \theta), \mathrm{Yi}) \tag{2}$$

Finding the best θ* that minimises the loss function over the training dataset D is the goal of the training procedure.

5 CONCLUSION

To sum up, a significant step in the right direction in the early location and proactive treatment of fish illnesses through water quality boundary evaluation has been accomplished by consolidating AI philosophies, especially troupe learning methods like irregular woods and slope helping, with reasonable simulated intelligence methodologies like SHAP values. Utilizing an enormous dataset that incorporates significant measurements for water quality and pointers for fish wellbeing, the proposed framework shows striking prescient capacities. This is demonstrated by the high level inclination supporting calculation, which accomplished a striking 95% exactness rate and an accuracy score of 0.98.

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Technology-driven facilitators for sustainable tourism: A case study of Rishikesh, the yoga capital of the world

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ABSTRACT: Sustainable tourism is a simple concept that needs to be mobilized for a hit. Policies based entirely on design concepts are desirable in order to implement sustainable and economic tourism. Continuous rewarding and learning are psychological translation to support tourism practices in reasonable worth value. Integrating knowledge from different sources of literature, within the unattached model situation, and organizing it as a tool of additives that are connected by holistic, adaptive, complex systems. The relationship between the elements that make up the definition and focuses on contribution to more than a list of elements, this comprehensive approach to find interrelationships which will help to navigate and spread the challenges of sustainable and economic tourism in Rishikesh (Uttarakhand) and yield suggested alternatives.

Keywords: Tourism, Sustainability, Technology, Economic, Mobility, Yoga hub

1 INTRODUCTION

Sustainability in tourism typically, offers prospective of being a decent and viable, income source. With the universal prominence on sustainability and fighting climate change, this creates a foremost prospect to point the Indian tourism experience as a distinct visitor carry off. Sustainable tourism has become a gradually more accepted field of research for years in terms of the impact on need for tourism, resource characteristics, role of tourism in sponsoring sociocultural evolution, the essential of intragenerational impartiality, the dimensions of sustainability and structures of sustainable development.Since tourism is a resource-intensive industry, it must be held accountable for sustainability on a broad scale. In small developing states, tourism development is crucial for boosting the economy, but its management raises concerns about trade-offs between network services and culture identities (Grilli 2021). It is argued that sustainable tourism needs to be envisaged in a broader way so as to review significantly its interconnectedness with the social and economic elements at various scales and time phases. A constantly emerging and economically significant industry both locally and globally is tourism. It is intended to result in the management of all resources in a way that maintains natural diversity, cultural stability, vital ecological processes, and life-supporting systems—all while meeting social, economic, and aesthetic criteria.

(Lu and Nepal 2009). One of the main factors in the growth of the term sustainable tourism is the growth of an up keeping visualization (Hardy *et al.* 2002). Sustainable tourism is one of the prime approaches in which hierarchies of differentiated dexterity are produced,

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retained and experienced (Sheller 2020). After the World Health Organization designated COVID-19 to be a pandemic in March 2020, the tourism industry has undergone a dramatic change (Seyfi *et al.* 2020).

1.1 *Profile of Rishikesh (Uttarakhand)*

Rishikesh is a well-known city of Uttarakhand (India), situated in the banks of holy Ganges, surrounded by the Himalayan Mountains and is recognized as a destination for tourism and cultural activities. Landscape of Rishikesh is combination of plains and hills and it comes under the bha bhar and terai zone. Tourism is a principal provider to the economy of Rishikesh. In the latest time, lacs of tourists visit Rishikesh during the peak season (April-August). The concept of sustainable tourism is founded on the areas that draw tourists' ecological, social, economic, and cultural qualities.

2 LITERATURE REVIEW ON TOURISM DEVELOPMENT

One of the research areas pertaining to sustainability issues that has been presented in the literature by various academics over a considerable amount of time is the idea of sustainable tourist development. A selection of them can be found below: The idea of sustainable development was first based on the idea of economic expansion (Sharpley 2020). Development of sustainable tourism is necessary for economic prosperity (Gomez *et al.* 2021). Thanks to the development of new technology, social media is playing a bigger role in tourism marketing campaigns, and tourists want to utilize it for all kinds of reasons, such as organizing, fulfilling, and disseminating travel experiences (Hysa *et al.* 2021).Sustainable tourism can be an efficient running mechanism for securing and benefiting natural resources, guarantees advantages for the current generation as well as for the future ones (Sgroi 2020). Stakeholder cooperation, perseverance, and an effective strategy are necessary for the rural tourist industry to thrive sustainably (Purnomo *et al.* 2019).With the view of various dimensions of sustainable development, it is evident that socio-economic dimensions play a significant role in achieving sustainability in tourism but during recent years, environmental dimension is mostly considerable and efforts need to be made towards those achievements (Navarro *et al.* 2019). Destinations providing ecotourism must adopt policies and procedures that consist of sustainability and strategies that support risk distancing to remain competitive (Ashraf *et al.* 2020). For sustainability in tourism value chain, transformation in key working areas such as internal management, product/service management, co-operation with destinations, supply chain management and CRM need to be add on (Ariya 2021). Assumed sustainability, with its social-economic, cultural, and environmental components, can serve as a criterion for categorizing tourism and aid in the development of end users' comprehension of the ways in which tourism-related goods and services are used (Cavalcante *et al.* 2021). The need for tourism destinations to be developed responsibly has made it crucial to design experiences that enhance visitors' perceptions of the destination's sustainability and level of expertise (Breiby *et al.* 2020). It shows that tourism is unfavorably reasonable for the consequence of economic growth on ecological deprivation. Hence, the marginal effect shows that higher the intensity of tourism, the higher the insignificant effect of economic growth on ecological deprivation (Ehigiamusoe 2020). A growing array of approaches encourages tourist growth with the aim of providing the local populace with sustainable means of survival. However, Dahles (2020) asserts that this is not, in essence, the voice of those who stand to gain. With the aid of the government's adaptable attitude, innovation, technology, market players, and industrial workers, the tourism business may wind up growing in a lot more sustainable approach following the pandemic (Sharma *et al.* 2020).On the basis of above literatures following questions arise:

RQ1. What are the existing sustainable resources to enhance economic development from tourism activity in Rishikesh (Uttarakhand)?

RQ2. What are technological advancements towards Tourism Sustainability in Rishikesh?

3 CONCEPTUAL FRAMEWORK

Rishikesh is one of the major tourist and travel destinations in North India, where people from all over the world come in search of peace. Rishikesh is often called the 'Yoga Capital of the World' and rightly so. Tourists coming here to practice yoga and illusions are booming the destination. Rishikesh has many ashrams, some of which are recognized internationally as centers for philosophical studies, yoga, and other ancient Indian traditions of wellbeing. It has many sustainable development goals as ornamented by nature. There are many exciting adventures like river rafting, camping, trekking, paragliding, bungee jumping etc. It's also the first city in India to introduce bungee jumping. With the existing natural resources, the economy of Rishikesh is growing rapidly by creating employment opportunities for the local youth, and supporting the community in various developmental strategies. Following are the main features i.e. yoga, spirituality, adventure and wellness centers are presented in the outline below as shown in Figure 1. Modularity in the development of the conceptual model, whose function as a guiding framework rather than a permanent final model, allows for the combination of emerging innovations and their testing to be tested in different context. In contemporary times, it is clear that technological progress has increasingly focused on mobility and automation among the drivers of sustainable and economic tourist.

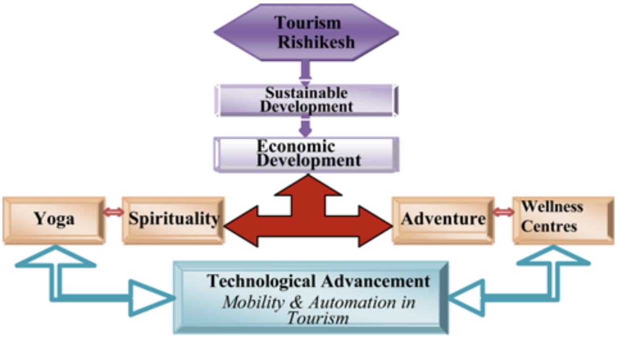

Figure 1. The study's conceptual framework (Source: Researcher's Compilation).

3.1 *Key points to be addressed*

Placing a high priority on environmental protection through waste management strategies, initiatives, and sustainable land use practices, Rishikesh's natural resources are safeguarded for coming generations. This also strengthens Rishikesh's appeal as a green travel destination. While Rishikesh benefits economically from the inflow of tourists, the sacred Ganges is suffering from unrestrained pollution, endangering the delicate balance of its environment. In Rishikesh, satisfying the many needs of visitors and promoting a more sustainable local community go hand in hand. One of the hotel industry's easiest methods to give back to the community is to create jobs. Hotels are in an excellent position to hire locals because of the synergy that exists between them and local businesses, which typically results in increasing employment demands. Situated on the banks of the Ganges, in the foothills of the Himalayas, is the picturesque town of Rishikesh. In addition to drawing millions of pilgrims from India and other countries, it is well known for its connection to the legendary British rock group The Beatles. By using responsible travel, one can take advantage of a comprehensive urban upgrading plan that includes sustainable design principles, green infrastructure, and heritage conservation sites like the one where Lord Rama atoned for his sin of killing Ravan to free Sita. Ram's brother Lakshman crossed the Ganges with the help of two jute ropes, which increased Rishikesh's allure and practicality as a tourist destination. Adopting sustainable tourist practices encourages environmentally friendly modes of transportation and improved waste management. Yoga can continue to flourish in Rishikesh. Hotels are adopting state-of-the-art technologies like predictive guest room technology, AI and data-driven solutions, green infrastructure, and smart lighting to drastically lower energy consumption and operational costs. For instance, solar panels can be used for heating and cooling instead of energy efficient LED lighting. The carbon emissions from the trip could make climate change worse. When feasible, combine ecologically friendly modes of mobility like walking, cycling, or public transportation with sustainable tourism. In contrast to other vehicles, auto rickshaws produce less pollution. For this reason, they are an environmentally benign mode of transportation. Moreover, they have a lower carbon footprint. utilizing different modes of transportation to get to work every day, eating more food that is grown nearby, giving up disposable water bottles, and using less electricity when not in use are all examples of sustainable living.

3.2 *Technology's role in advancing and improving environmentally friendly travel*

Websites and mobile applications provide information to travelers on environmentally friendly transportation options, sustainable lodging, and ethical tour operators. Improve their internet visibility, establish a connection with their intended audience, and eventually succeed in a cutthroat market. Experiences in virtual reality, online tools for planning and booking travel, AI-powered personalized travel suggestions, and destination marketing via social media Technology can be used to optimize transportation networks to make them more energy and environmentally efficient. This entails driving electric vehicles, reducing the amount of time spent driving alone by using ride sharing services, and putting sophisticated traffic management systems in place to reduce traffic congestion and fuel consumption. When integrating developing technologies into the transportation system, safety, responsiveness, integration, and sustainability are given top priority in order to accomplish both environmental sustainability and economic development through access to mobility.

Virtual tours are made possible by these technologies, allowing consumers to visit places without having to physically visit them. In addition to promoting intercultural dialogue, this can mitigate the damaging impacts of tourism on the environment. Big data analysis can help travel locations manage visitor flows more skillfully. By understanding tourist trends and habits, authorities can implement measures to protect vulnerable ecosystems, avoid crowding, and ensure a better overall tourism experience. Infrastructure related to tourism can be made far less harmful to the environment by comprising solar cells, windmills, and additional renewable energy sources. This includes hotels and other eco-friendly accommodations as well as electric vehicle charging points.

Smart waste management solutions can help places handle the extra trash from tourists in a sustainable way. The utilization of recycling technologies and tourism-related waste management practices can help mitigate the negative environmental effects and data analytics and sensors to optimize garbage collection routes. Unlike traditional incinerators, the fuel-free solid waste disposal technology known as "kill waste" employs basic machinery and doesn't require any technicians or maintenance. Block chain technology can be used to make supply chains in the travel and tourist industry transparent and traceable. This ensures that products and services that claim to be sustainable or eco-friendly actually meet such standards.

Blockchain facilitates transparency by giving everyone access to the data stored on the network. Through, the use of technology, travelers can learn about ethical and sustainable travel practices. Smartphone apps can provide information on local customs, green efforts, and efficient strategies to decrease the effect on the surrounding. In Rishikesh, you can order any kind of online puja, including Pind daan, Asthi Visarjan, Narayanbali, and Navgrah Shanti pujas. For improved visibility to bigger groups, aarti ceremonies were broadcast on an LED screen. Modern lighting design to improve the aarti ceremony's atmosphere and aesthetic appeal. Techniques for delivering schedule notifications through mobile applications.

4 DISCUSSION

The concept of tourism in Rishikesh is presented on the basis of the following factors as shown in Figure 2:

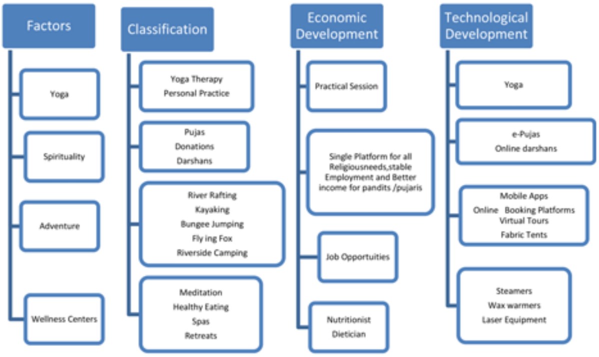

Figure 2. Study's theoretical structure (Source: Researcher's Compilation).

4.1 *Yoga*

The advent of virtual instruction is one of the biggest developments in yoga. People may now practice yoga regardless of their location or schedule thanks to online resources, mobile apps, and video tutorials like the Yoga Studio by Gaiam. With so many classes and styles at their fingertips, yoga practitioners may experiment with different teachers, learn from diverse traditions, and tailor their practice to meet their individual requirements. More flexibility is also made possible by virtual instruction, since users can customize their practice to fit their preferences and goals by selecting the length, intensity, and focus of each session.

4.2 *Spirituality*

Pujaris now serve a far wider range of clients thanks to the growing popularity of online pujas and darshans. As a result, they may charge more for services like online astrology consultations, darshans, pujas, and temple donations made online, which allow them to make a more consistent and higher income.

4.3 *Adventure*

Adventure tourism stands out as a significant contributor to India's economic dynamics, where tourism plays a crucial role. Bungee jumping in Rishikesh has been known as the "adventure capital of India."

4.4 *Wellness-centres*

An effective intergenerational wellbeing strategy changes economic structures and advances a more comprehensive view of people's well-being as a whole. Online gyms, online training programs, and other resources are easily accessible to fitness and wellness aficionados thanks to the new connected capacities and virtual solutions. Wellness applications use artificial intelligence (AI) to continuously monitor your eating habits, progress, diet plans, and mental health in order to keep you motivated.Many travelers who are looking for yoga retreats, meditation centers, and adventure sports like river rafting, trekking, and camping come to Rishikesh. Nowadays, jobs in a range of industries are available to locals, such as hospitality, tourism management, adventure sports guiding, yoga instruction, and wellness services, thanks to the rise of yoga, spirituality, adventure, and wellness centers. An increase in tourism frequently necessitates the improvement of infrastructure, including roads, lodging, transit hubs, and recreational areas. Technology is used by many operators of adventure tourism and wellness centers for marketing, reservation systems, and client interaction. To reach a larger audience and streamline processes, this may entail the use of websites, smartphone apps, social media platforms, and online booking platforms. Investments in digital infrastructure, such as Wi-Fi hotspots, digital payment systems, and high-speed internet connectivity, are frequently motivated by the need to accommodate modern tourists.

Local business owners may find possibilities to innovate in health technology as wellness tourism develops. Due to its status as a center for yoga and spirituality, Rishikesh draws researchers and students from all over the world. The creation of instructional apps, online learning platforms, or digital content about yoga, meditation, and health practices may result from this surge of interest in these areas. In order to guarantee the sustainability of natural resources, there might be a need for environmental monitoring systems as adventure tourist activities like trekking and rafting grow in popularity. This could entail using drones, Internet of Things (IoT) devices, or other technologies to monitor the condition of forests, water quality, and wildlife conservation initiatives.

5 CONCLUSION

A conceptual model framework for research thinking that has been successfully applied in practice has been provided in this paper. The different elements that make up the technological and economic development components of yoga, spirituality, adventure, and wellness facilities are underlined in this classification scheme. The framework can initiate an exploration of the true relationships among these components by clearly recognizing their equal significance. These are intended to improve the validity and dependability of the research tools and results.

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Under graduate programme PO and PSO attainment Deep learning

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ABSTRACT: Outcome based Education (OBE) is the standard and most of the institutions are adopting the OBE. In this method, after graduation students will success in their carrier. In existing methods are traditional way of teaching and students scoring only marks so not possible to better employability. OBE is implemented to produce all the graduates are employable and follows OBE standards in engineering programmes. In this paper we use empirical deep learning approach to calculate the attainment of Programme Outcomes (POs) and Programme Specific Outcomes (PSOs). Here we use under graduate engineering batch and their performance is taken for evaluation. Overall attainment calculated based on each courses attainment results and activities. At the end, we test the batch wise results and compare the performance.

Keywords: Deep Learning, Attainment, Assessment, Programme Outcomes, Programme Specific Outcomes

1 INTRODUCTION

Nowadays all the institutions in India such as Engineering, Medical, Pharmacy, Polytechnic colleges are following outcome based education. OBE is implemented means institutions can approach various accreditation and standards. For example, India National Board of Accreditation (NBA) and National Assessment & Accreditation Council (NAAC) are obtained based OBE. While implementing OBE lot of difficulties and barriers are there. Because institutions can change their traditional teaching and learning practices into modern or OBE based standards [1].

In this case faculty need to train OBE standards and implement the process into regular activities. It has multiple stages. Institute can set vision and mission based on the each department can fix their vision and mission statements. Once it is framed each programme can specifies Programme Outcomes and Programme Specific Outcomes. POs are derived

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from graduate attributes which is given by All India Council for Technical Education (AICTE). PSOs are framed based on programme scope and it is not covered in POs [2,3].

Once it is done need to identify the curriculum structure of each programme. Programme consists of semester wise courses with the guidelines of AICTE and affiliating university. Each courses have course outcomes which is measurable one [4]. Courses outcomes are mapped with POs and PSOs from the correlation factors. In this paper we considered EGSPEC, Dept. of IT (B.Tech-IT) POs,PSOs and courses for attainment calculation. This paper organize Section 2 gives literature review, Section 3 gives OBE implementation process, Section 4 explain assessment and attainment, Section 5 gives performance and results.

2 RELATED WORKS

Abet and Washington Accord (2021) are world best accreditation agency for validating degree. The followed outcome based education system for implementing teaching learning and supplementary process activities. As the result major changes are in educational systems and revolutions. In India 2010 onwards started implementing OBE systems and past 10 years all the institutions are changed to OBE standards [5]. As the status a student got degree from India with NBA means same degree can be equivalent to other nation's degree. That much power and values are given for accreditation with the support of OBE [6].

Manikandan *et al.* (2021), gave the result of course outcome and attainment calculation for the particular course. Which gives the results about attainment and inference status? From the results continuous monitoring and changes delivery method can be done for better results [7]. Wong *et al.* (2022), instead of delivery methods add or changes in assessment method more support to get better results [8]. As the results shows continuous monitoring and changes in the pattern give better results.

Attainment process can be done automated and results will be given based on various data visualization results. Deep learning methods are suggested to process the data and iterate the results. Various techniques such classification of data, cluster the dataset and processing the dataset can be done [9]. Runga and Xia Yen *et al.* (2023), suggested attainment processes are repeated work and need of proper recording system is required. Based various literature we propose attainment method for assessing the performance [10,11].

3 ASSESSMENT AND ATTAINMENT: A PROCESS

Assessment and Attainment are the two important factors to determine the OBE process. OBE is the process it is not a calculated or quantitative approach. It is used for improving the performance and drive the system. Vision and mission of the institute and department are the inputs. Based on that PEOs are framed [12,13], it means after graduation after 4 or 5 years how the graduates are there and which level are there to be measured. POs and PSOs are measured at each batch or year performance. Above Table 1 shows that block diagram of OBE process.

Table 1. Status of process flows.

Vision and Mission	After 15 year how the department/institute status – Long term process
PEOs	After graduation after 4 to 5 years status of graduates
POs and PSOs	Every year batch wise performance and status
Course Outcome attainment	Each semester courses results and attainment

Table 1 show that attainment process flows. Attainment is obtained by using curriculum and courses are offered by the programme. In this paper we used IT curriculum and courses which offered for 2019–2023 batch students of EGSPEC [14,15].

In this stage each courses are mapped with POs and PSOs shown in below Table 2. The levels are fixed as 3 statuses such as Substantial (3), Moderate (2) and Slight (1). If not mapped means that course not support the PO and PSO. For the each courses course outcome are defined based on bloom taxonomy knowledge levels and mapped. Once it is done various teaching learning process activities are taken for assessing students' performance. Assessment pattern can be fixed by concern faculty based on theory, laboratory, theory combined lab courses, project works and activities.

4 EMPIRICAL DEEP LEARNING METHOD – ATTAINMENT OF POS AND PSOS

The POs and PSOs attainment calculations are done by using all the course outcomes attainment results and surveys. The below Figure 1 shows that process flow of attainment of POs and PSOs.

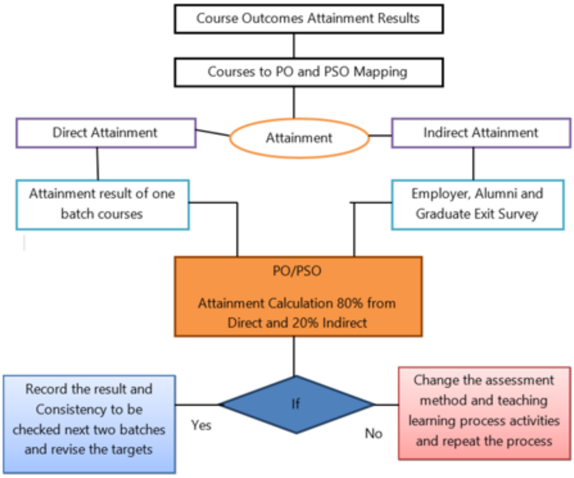

Course Outcomes Attainment Results
Courses to PO and PSO Mapping
Direct Attainment
Attainment
Indirect Attainment
Attainment result of one batch courses
Employer, Alumni and Graduate Exit Survey
PO/PSO
Attainment Calculation 80% from Direct and 20% Indirect
Record the result and Consistency to be checked next two batches and revise the targets
Yes
If
No
Change the assessment method and teaching learning process activities and repeat the process

Figure 1. Process diagram of POs and PSOs attainment.

From the above representations particular batch (2019–2023) complete courses and activities attainment are taken for attainment calculation of POs and PSOs. Based on course wise PO and PSO mapping each attainment values are recorded. Also survey collected from alumni, employer and graduates. 80% weightage given to direct and 20% weightage given to indirect. Final result is recorded.

Table 2. Indirect attainment result of course to PO and PSO.

Survey	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
Alumni Survey	2.78	2.71	2.81	2.76	2.72	2.31	2.38	2.49	2.52	2.48	2.49	2.51	2.75	2.76	2.76
Employer Survey	2.7	2.76	2.5	3	2.81	2.23	2.12	2.18	2.19	2.16	2.92	2.85	2.75	2.92	2.92
Graduate Exit Survey	3	3	2.76	2.81	2.76	2.82	2.54	2.44	2.14	2.27	2.76	2.91	2.93	2.78	2.78

From the above Tables 2 and 3 shows that empirical deep learned results of direct and indirect attainment results of PO and PSO. In below section overall attainment and comparison of batches are discussed.

5 PERFORMANCE EVALUATION

From the process flow and attainment polices we are taken direct and indirect attainment results and finally we got PO and PSO attainment of EGSPEC-ITR2019 (2019–2023) batch students.

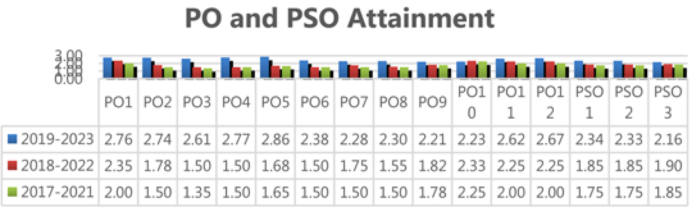
Table 3. PO and PSO attainment.

Direct	2.95	2.46	2.02	1.67	1.76	2.45	2.42	2.36	2.24	2.29	2	2.18
Indirect	2.34	2.35	2.28	2.38	2.34	2.23	2.18	2.18	2.15	2.16	2.36	2.36
PO & PSO Attainment	2.92	2.45	2.03	1.71	1.79	2.44	2.41	2.35	2.24	2.28	2.02	2.19

Next the target comparison can be done. Each POs and PSOs target to assign based on previous batch performances average and guidelines of AICTE model curriculum. The below Table 4 shows that target and attainment results. Above table is the result of PO and PSO target and attainment. The above results and target can be tested next two batches for consistency. Once achieved means target can be increased. If target is not achieved means course outcome attainment process results are taken and changed delivery and assessment methods of teaching learning practices.

Table 4. Comparison of PO and PSO attainment.

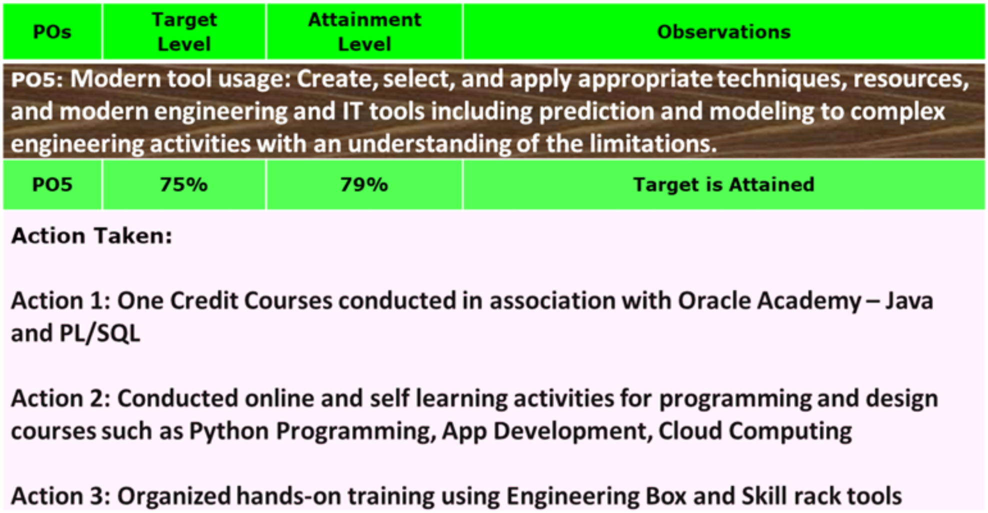
	PO and PSO Attainment					
	2019–2023		2018–2022		2017–2021	
PO & PSO	Target	Attained	Target	Attained	Target	Attained
PO1	1.70	2.76	1.45	2.35	1.23	2.00
PO2	1.69	2.74	1.09	1.78	0.92	1.50
PO3	1.53	2.61	0.88	1.50	0.79	1.35
PO4	1.72	2.77	0.93	1.50	0.93	1.50
PO5	1.69	2.86	1.00	1.68	0.98	1.65
PO6	1.13	2.38	0.71	1.50	0.71	1.50
PO7	1.10	2.28	0.85	1.75	0.72	1.50
PO8	1.06	2.30	0.72	1.55	0.69	1.50
PO9	1.18	2.21	0.97	1.82	0.95	1.78
PO10	1.17	2.23	1.22	2.33	1.18	2.25
PO11	1.43	2.62	1.23	2.25	1.09	2.00
PO12	1.50	2.67	1.26	2.25	1.12	2.00
PSO1	1.23	2.34	0.97	1.85	0.92	1.75
PSO2	1.19	2.33	0.95	1.85	0.89	1.75
PSO3	1.12	2.16	0.98	1.90	0.96	1.85



	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
🟦 2019-2023	2.76	2.74	2.61	2.77	2.86	2.38	2.28	2.30	2.21	2.23	2.62	2.67	2.34	2.33	2.16
🟥 2018-2022	2.35	1.78	1.50	1.50	1.68	1.50	1.75	1.55	1.82	2.33	2.25	2.25	1.85	1.85	1.90
🟩 2017-2021	2.00	1.50	1.35	1.50	1.65	1.50	1.50	1.50	1.78	2.25	2.00	2.00	1.75	1.75	1.85

Figure 2. Comparison of PO and PSO attainment targets in each batch.

The above Table 4 and Figure 2 shows that each year PO and PSO attainment is recorded so faculty can check the results based on that they can revise the content delivery and assessment methods for each courses and activities.



POs	Target Level	Attainment Level	Observations
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.			
PO5	75%	79%	Target is Attained

Action Taken:

Action 1: One Credit Courses conducted in association with Oracle Academy – Java and PL/SQL

Action 2: Conducted online and self learning activities for programming and design courses such as Python Programming, App Development, Cloud Computing

Action 3: Organized hands-on training using Engineering Box and Skill rack tools

Figure 3. Sample action plan conducted after the results.

From the above Figure 3 shows that action taken details of particular PO. This continuous process can be done by the department to check the level of the students as well as teaching learning practices. Every department conduct programme assessment committee to discuss the above results and taking effective decision for upcoming implementations.

6 CONCLUSION

Outcome based education is used by many of the college to improve the performance towards accreditation for better employability. In this paper we proposed empirical deep learning approach to measure the PO and PSO attainment of under graduate engineering programme. Here course outcome attainment of all the courses is taken for particular batch and direct, indirect attainment tools are used to measure the attainment. Finally, PO and PSO attainment calculated for one batch. Then the results are compared with existing batches results. If attained means revise the target and continues the process, if not necessary action to be taken. In future may the support vector based assessment method will be used.

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Deepfake detection using fine-tuned VGG16 model: A transfer learning approach

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ABSTRACT: Surge of deep fake videos, enabled by advancements in AI, present a grave challenge to the trustworthiness of visual material. To confront this issue, we present a fresh deep fake detection system that relies on facial embeddings and fine-tuned VGG16-based models. Through capturing subtle facial features and rigorous training with meticulously curated datasets, our system contributes in distinguishing authentic content from manipulated ones. Equipped with a robust real-time video processing pipeline, our approach acts as a proactive shield against the proliferation of false information, thereby preserving the credibility of digital media. By amalgamating deep learning and transfer learning methodologies, our system provides a reliable strategy to combat the malevolent use of deep fake technology. Leveraging sophisticated algorithms and evaluation metrics, we aim to mitigate the risks associated with digital manipulation, ultimately upholding the trustworthiness and authenticity of visual content in the intricate landscape of the digital age.

Keywords: MTCNN, CNN, VGG16, Inception Res Net V1, Deep fakes, Transfer Learning

1 INTRODUCTION

The rise of deepfakes offers a serious threat to the trustworthiness of visual content. These advanced machine learning techniques can alter videos by swapping or modifying faces, raising concerns about their potential to mislead and spread false information. As deepfake technology becomes more accessible, the need for robust detection methods to combat widespread deception is growing.Our research introduces a new deep fake detection system that uses facial embeddings and a fine-tuned VGG16 model. By leveraging detailed facial characteristics and a well-curated dataset, our system aims to accurately differentiate between authentic and manipulated faces.

Combining Multi-Task Cascaded Convolutional Neural Networks (MTCNN), Inception Res Net V1, and a finely tuned VGG16 model, we enhance our ability to detect altered content, making a significant contribution to deep fake detection. This effort not only addresses a crucial gap in knowledge but also shows promise in preserving the authenticity of digital media and rebuilding trust in visual content amidst the challenges of the digital age.

2 LITERATURE SURVEY

With the ever-growing concern about the impact of deep fakes, researchers are developing various strategies for their detection. Demir et al. [1] focused on extracting features and assessing temporal consistency, using Support Vector Machines (SVM) or Convolutional Neural Networks (CNN) to analyze biological signals in facial regions.

Deep learning approaches are increasingly important in deep fake detection, with DARPA even starting a research program dedicated to this field [2,3]. Studies have explored methods that leverage temporal, spatial, and spectral inconsistencies using multimodal deep learning [5]. This approach, along with the work presented in [6], which uses a pair-wise deep

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learning model on the Celeb A dataset, has shown promising results, with accuracy rates exceeding 90% in deep fake detection.

Using Convolutional Neural Networks (CNNs) is another popular method, with advancements like Meso Net incorporating dilated convolutions to capture multiscale information [9]. These CNN-based approaches often target facial distortions or use high-pass filters to detect statistical irregularities introduced by GANs [9,10]. While they generally show high accuracy, the lack of standardized datasets across various methods makes it difficult to directly compare and identify the best approach [11].

More recent research has focused on improved image classification models for videos, merging some of the best aspects of existing architectures to create more robust and adaptable systems [13]. Additionally, deep learning frameworks based on the VGG16 architecture has achieved impressive accuracy rates exceeding 90% in deep fake detection, with further advancements integrating CNNs to achieve even higher accuracy of 94% [14,15].

Facial embeddings and fine-tuning deep learning models like VGG16 have proven particularly effective, with the integration of algorithms like CNN and LSTM showing significant promise in reducing false positives and improving detection rates [7]. This highlights the importance of robust feature selection and model optimization in deep learning approaches for deepfake detection. Despite these advancements, further exploration is needed to address challenges concerning latency and reliability in deep fake detection systems [10].

3 PROPOSED SYSTEM

Deep fakes pose a challenge to the reliability of digital media, demanding for efficient strategies for detecting and mitigating deep fakes. Researchers have leveraged some advanced ML techniques, specifically deep learning, to address this issue. One effective approach involves using fine-tuned Convolutional Neural Networks (CNNs) and facial embeddings, which capture essential facial features for classification. These embeddings, derived from the pretrained InceptionResNetV1 model, enable accurate differentiation between genuine and deep fake visuals. This approach of using the knowledge gained from one task to enhance performance on another is known as Transfer Learning, as illustrated in the Figure 1.

The process of deep fake detection involves several steps. First, a diverse dataset of authentic and deep fake media is collected and prepared. Video frames and facial regions are extracted to focus on key features for classification. These cropped images are then used to generate facial embeddings. The fine-tuned VGG16 model, renowned for its ability in image classification, is utilized for deep fake detection. It involves customizing the top layers and adding custom fully connected layers on top of the base model. The model is then trained on the extracted facial embeddings, with labels indicating whether the content is authentic or deep fake. In addition to the above, this paper presents a unique approach to identify deep fake videos, combining facial embeddings with a fine-tuned deep learning model designed specifically for deep fake classification. The core of the system involves adjusting the deep learning model to classify faces as genuine or manipulated by utilizing facial embeddings extracted from cropped face areas in video frames. The model undergoes extensive training on a carefully curated dataset containing both authentic and manipulated facial embeddings, with its top layers customized to detect subtle indicators of manipulation. Integrated with video processing techniques, this method enables efficient deep fake detection at both frame and video levels.

After training, the model was evaluated using a separate test dataset to determine how well it detects deep fakes. We calculate performance metrics such as precision, accuracy, F1-score, and recall. To improve the model's performance and its ability to generalize, we might use optimization techniques like hyperparameter tuning and regularization. In summary, using fine-tuned CNN architectures with facial embeddings shows great promise for deep fake detection. This approach effectively combines deep learning and computer vision techniques, providing a strong defense against the spread of deepf ake videos and helping to maintain the integrity of multimedia content in the face of growing digital manipulation.

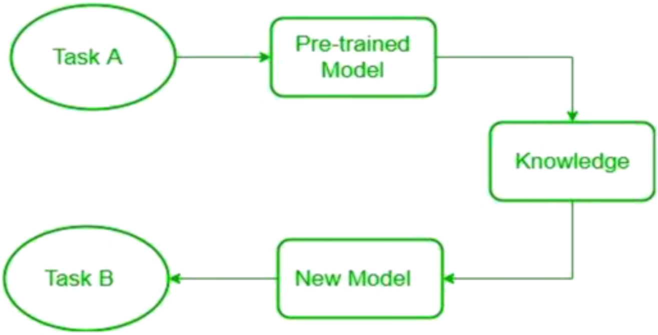

Figure 1. Transfer learning.

4 RESULT AND ANALYSIS

The result report outlines performance of the deepfake detection model on a test dataset, comprising 450 samples. Table 1 in the report assesses the precision, recall, and F1 score for each category, as well as the overall accuracy.

Table 1. Result of the fine-tuned model.

	Precision	Recall	F1 Score	Support
Fake	0.98	0.95	0.96	225
Real	0.95	0.98	0.96	225
Accuracy		0.96		450
Macro Avg	0.96	0.96	0.96	450
Weighted Avg	0.96	0.96	0.96	450

4.1 *Precision*

Precision gauges the correctness of positive predictions. For the FAKE category, the calculated precision is 0.98, meaning that 98% of the samples identified as FAKE are truly FAKE. In contrast, for the REAL category, the precision is 0.95, suggesting near-perfect accuracy, indicating that 95% of the samples labeled as REAL are accurate.

4.2 *Recall*

Recall, also referred to as sensitivity, gauges the percentage of true positives accurately identified by the model. The model attained a recall score of 0.95 for the FAKE category, indicating that it correctly classified all FAKE instances. Conversely, the recall for the REAL category stands at 0.98, denoting that 98% of REAL instances were correctly identified.

4.3 *F1 score*

The F1-score, which is calculated as the harmonic mean of precision and recall, provides a balanced evaluation of a classifier's performance. Specifically, the F1-score of 0.96 for the FAKE class signifies a strong equilibrium between precision and recall, while the REAL class's F1-score of 0.96 indicates a satisfactory balance between precision and recall as well.

5 CONCLUSION

In conclusion, we aimed to address the urgent issue of identifying deep fake videos, which present considerable risks across multiple domains such as media, politics, and cybersecurity. By using machine learning methods, specifically CNNs, we aim at making a detection system that can effectively tell the difference between real and fake videos. Following an extensive assessment using a varied dataset, our model showcased impressive performance, attaining an overall accuracy rate of 96% on the test dataset.. Our analysis shows promising results in the model's performance, with high precision and recall for both FAKE and REAL classes, maintaining a balanced F1-score despite a minor recall discrepancy. This underscores our methodology's effectiveness in combating deep fake content and misinformation spread. Our study contributes to deep fake detection progress by offering a solution applicable across domains. The performance analysis curve depicted in Figure 2 provides a detailed breakdown of the model's performance.

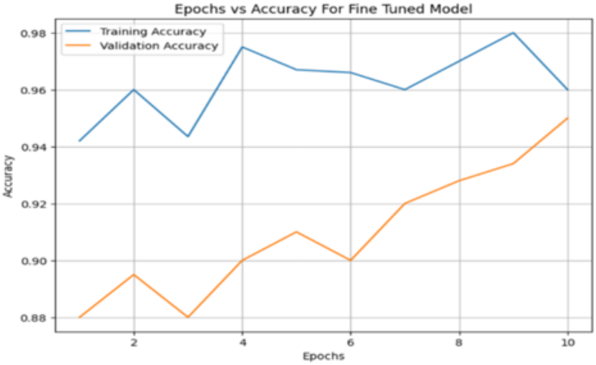

Figure 2. Performance analysis (Epoch Vs Accuracy).

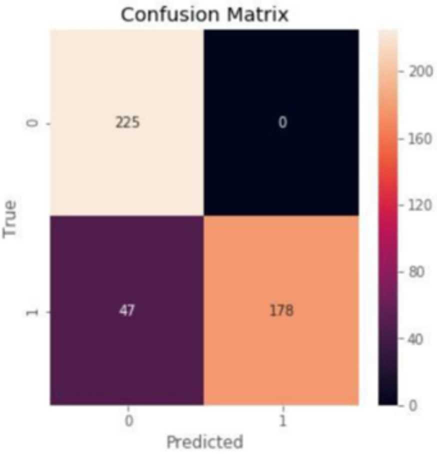

Figure 3. Confusion matrix.

Figure 3 confusion matrix gives a detailed overview of how well the model is classifying instances into the correct categories.

In conclusion, our research represents significant advancement in deep fake detection, providing an improved framework for advanced detection systems to uphold digital integrity in digital space.

6 LIMITATIONS AND FUTURE SCOPE

Detecting deepfake videos successfully is a notable achievement, yet it's crucial to recognize limitations and chart future research paths. Enhancing deep fake detection models involves addressing pivotal challenges, notably minimizing data bias. Ensuring a diverse, representative, and high-quality training dataset is essential. Future efforts should prioritize creating a robust dataset to boost model accuracy. Improving the model's generalization across diverse deep fake techniques and environmental conditions is crucial for robustness, necessitating strategies to enhance adaptability and resilience to new data. Addressing vulnerabilities to adversarial attacks is equally vital to maintain system trustworthiness, requiring the development of defensive measures. Enhancing interpretability is key for understanding biases and rectifying errors effectively. Additionally, scalable real-time processing systems are essential for applications needing immediate responses, urging exploration of innovative algorithms and infrastructure.

In summary, addressing data bias, enhancing generalization, mitigating adversarial threats, optimizing resource usage, considering ethical implications, improving interpretability, and implementing real-time processing capabilities are pivotal areas for advancing deep fake detection technology.

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Enhanced SAR automatic object identification using residual inaccuracy CNN and PCA magnitude downsizing

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ABSTRACT: This paper details a method for automatic object SAR object identification based on combining the use of residual inaccuracy convolutional neural networks and magnitude reduction of the PCA. The entire method must collect SAR destination picture data and annotation it with item classes to establish a training set for constructing the training set training samples must be enhanced, multiply and pre-processed before utilizing convolutional neural networks with residual inaccuracy. The network model formed is used to transmit training samples into the network for training. When new training sets are premade, the feature vectors are extracted via the network at this moment, it uses magnitude downsized via the PCA method, trained utilizing a multi-class SVM classifier. Finally, by feeding pre-processed sample data into the network for identification and an SVM classifier for identification after PCA magnitude reduction can be used for training SVM. This technique effectively resolves the regular poor identification accuracy difficulty in current SAR Object Identification systems.

Keywords: inaccuracy convolutional neural networks, PCA magnitude downsizing, SVM classifier, feature vector, magnitude downsizing, identification precision

1 INTRODUCTION

In the field of remote sensing, plant Synthetic aperture radar technology has attracted a vast amount of interest because of its capabilities to produce images in all weather and high resolutions. For a variety of purposes, synthetic aperture radar pictures are widely useful; some of them are surveillance, reconnaissance, and object detection. However, it is challenging to identify objects utilizing synthetic aperture radar pictures' accuracy and rapidity. SAR object identification encounters some of the most severe challenges are the exploding number and complexity of SAR data. SAR photos can contain a huge number of pixels, each of which can have various amplitude and phase values. The complexity of SAR data makes it difficult to identify characteristics and patterns valuable in the raw data. Consequently, it is necessary to develop automatic The object identification (ATR) methods for SAR pictures that are both reliable and helpful [1–6]

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Over the past few years, many learning approaches have achieved significant progress in various computer vision responsibilities, including picture gathering, object recognition, classification, and much more. A CNN can learn layered versions of the incoming information, which means it may recognize complex capabilities and trends. However, characteristic examination and pattern extraction are hard with CNNs when used on SAR due to the large size of the SAR image and the lack of storytelling data. This study offers a new method for SAR object recognition, based on the use of R-CNNs and PCA to downsize the feature vector magnitude. The main goal is to downsize the vector length to improve probable identification by properly extracting discriminative features to SAR images. This method consists of several stages. In the first step, the formation of a training set begins with the collection of SAR destination picture data and object categorization. In the next step, this training set is refined, expanded, and pre-processed to allow better presentation of item variability. Residual inaccuracy CNNs are built and studied on rerolled training patterns [7–10]. After training, the NN model is used to extract feature vectors from fresh training sets. These vectors are then reduced in magnitude using PCA to reduce the complexity of the feature space. Finally, progressively the pre-processed to be identified SAR pictures are sent to the trained NN model. The extracted vectors are then output to PCA magnitudes and recognized with a support vector machine classifier prepared on the reduced space. This method seeks to eliminate the drawbacks of current object identification procedures and, at the same time, enhance this identification qualification. Our methodology aggregates the influence of residual inaccuracy CNNs to PCA magnitudes to enhance feature extraction and reducing the size of the SAR data, resulting in better and improved object identification [11–15]. Therefore, our present study is to develop SAR object recognition automated processes by aggregating residual inaccuracy CNNs to PCA magnitudes. The finding segments will expose our strategy, experimental arrangement, and realization, which demonstrates the use of our approach.

2 RELATED WORK

Synthetic aperture radar (SAR) is a high-resolution imaging radar technology that can detect even in low-visibility environments such as clouds and mist as the imaging effect is quite good. The advantages of robust penetration, high-resolution imaging, and large-scale monitoring make it can be used for environmental monitoring, maritime monitoring, ground mapping, and even military use. Consequently, SAR radar and SAR picture automated object recognition AOR are attractive research topics all over the world. A method referred to formerly explains the technique of locating SAR objects based on convolutional neural networks CNN.

The process entails numerous translations of sample pictures to produce extended training samples, building a CNN network using the Caffe framework, training the CNN using the expanded training samples, and testing the trained CNN with translated test samples. The downside of this approach is the use of a typical CNN structure, which leads to low proficiency and restricted extractability of additional features, resulting in lower SAR object detection rates.

The object was detected by a cascaded classifier through the method, which is based on SVM-based and matching algorithms. Furthermore, this method performed manual extraction and selection of the features. Consequently, this method should not be applied based on the specific purpose and difficult to adapt in many SAR object recognition applications, specifically suitable. In conclusion, some of the systems that were previously mentioned described the available techniques for the detection of SAR objects but with various limitations. The one based on typical CNN structure and the other with manual selection of the features have a characteristic new vulnerability for generalizability and overall identification precision that has to be overcome in the future techniques.

3 METHODOLOGY

(1) The SAR automated object recognition approach as PCA magnitude reduction connected with fusion residual inaccuracy convolutional neural networks. Figure 5 displays the flow of the method that aims to increase the accuracy and competency of SAR object detection. The steps of the technique are as follows:

(2) SAR destination picture data recording and method-specified training set creation for object classification: we select cycles of different and varied heights to bestow the technique as a practical exercise. Several classes can define the land tokens to distinguish diverse engendering situations. We have captioned 2000 SAR pictures for each class.

(3) Data cleaning and preparations in the training set: various methods have been accountable while we enlighten images normalization, de-noising, or picture amplification.

(4) Developing residual inaccuracy convolutional neural networks: Our original creation is the residual inaccuracy CNNs which are built and trained as the appropriate properties to collect the necessary information for SAR object detection. The design of CNN comprises convolutional layers, pooling layers, fully linked layers, and output layers.

(5) This CNN model is prepared with the training sample set from the second step. To increase the learning process for every convolutional and fully linked layer the parameters are initialized using the Xavier initialization process in a repetitive manner; CNN modifies its parameters concerning the enhancement of networks weights in the image by extracting more discriminative characteristics data within the cycles as training enhances. This one a residual inaccuracy conduct model at the end.

(6) Using the learned network model to create fresh training set: The inaccuracy CNN model as a training network aid us to extract the feature vectors from the original training data sets. The output feature on the average pooling layer provides us with a feature vector of the model where we obtain the total amount information the inaccuracy CNN has collected for a time period. These feature vectors are then utilized to generate a new training set including the learnt representations.

(7) Minimize the sample identification feature vector magnitude and delete repeated information through PCA: lower feature vectors quickly achieve the model's computational ability, and common capabilities are sent to an SVM classifier, which prepares them to perfect the SVM classifier.

(8) If needed, Test the recognized sample's identification boundary utilizing an SVM-based classifier: pre-process the sample to be determined into the network as accomplished above. After then, transmits the PCA parameter lowered feature vector and constructed in stages to the SVM trained yield the sample collection characteristics utilizing the experienced SVM-based classifier recognition. Extrapolating and perhaps associated the precision of fusion exposure residual inaccuracy CNN with PCA power decrease could enhance the sample's recognition effectiveness. To sum up, through these steps, a systematic and practical tool for object recognition in SAR images has been created. The steps have the potential to support other SAR imaging applications that need the total attention of the SAR image object automatic recognition.

Table 1. Illustrates the distribution of samples in the training and test sets.

Category	Model	Training Set	Test Set
BMP4	SN_9564	235	196
	SN_9567	-	197
	SN_C22	-	197
BTR72	SN_C72	235	197
	SN_134	233	197
T74	SN_814	-	198
	SN_S9	-	192
Total		699	1367

4 EXPERIMENT AND RESULT

The experimental study was conducted through a considerable-scale on widely used MSTAR dataset, which involves SAR images, for object discovery in SAR data. The specific target of the experiment was to detect the tertiary objects in the MSTAR dataset. Separate training and testing datasets were established, with each set comprising SAR pictures of three object classes: BTR72 , BMP4 , and T74 (tank). It should be noted that the BTR-72 and T-74 have three distinct variants depending on their equipment. The test set includes contained photographs from all three classes. To further optimize the training set, one model was selected from each of the BTR72 and T74 subtypes, for a total of 698 training samples. The test set contained 1365 samples of different categories in Table 1. The pixel size of all example photos is 128 by 128. For model training, we utilized 16 batches of training data; each iteration was performed 50 times, which gave us a total of 560 iterations. A validation set of 138 samples was used to assess the model's performance while training. The Adaptive Moment Estimation adaptive optimization method was utilized. Each convolutional layer and fully connected layer's parameters were determined by the Xavier weight initialization method. The Radial basis kernel function was used as the support vector machine classifier. For a k-class identification job, k (k-1)/2 classifiers were created, and the final identification result was chosen by a voting process that included the outcomes of all classifiers.

The efficiency of the technique was evaluated using four common performance indicators in classification tasks: distinctiveness, accuracy rate, retrieval rate, and F1 score. Distinctiveness refers to the proportion of correctly identified samples to the total number of test samples. The accuracy rate is the ratio of accurately detected positive cases to the total number of instances identified as positive. Retrieval rate is the ratio of properly identified samples within a certain category to the total number of samples in that category. The F1 score is the balanced average of the accuracy and retrieval rates.

By feeding the test set of 1365 SAR pictures into the trained residual inaccuracy convolutional neural networks, the resulting feature vectors were subjected to PCA magnitude reduction using the training set's downsizing matrix. The generated feature vectors were then utilized to identify objects using the trained SVM classifier. The identification performance was remarkable, with 99.39% discrimination, 97.28% accuracy, 99.46% recall, and an F1 score of 99.37%. These findings outperformed other published approaches in the field, as seen in Table 2. Table 3 shows detailed identification findings for distinct sample types.

Table 2. Illustrates the identification findings for distinct sample types.

Procedure	Identification Rate (%)
Gabor+TPLBP-ELAMP	95.8
Joint sparse representation	96.6
AdaBoost	97.12
Traditional CNN	96.9
This Invention	99.39

Table 3. Compares the procedure's performance to other SAR object identification algorithms.

	Test Result			
Test Sample	BMP4	BTR72	T74	Identification Rate (%)
BMP4 (SN 9564)	193	0	2	98.97
BMP4 (SN 9567)	188	2	6	95.92

(*continued*)

Table 3. Continued

Test Sample	Test Result BMP4	 BTR72	 T74	Identification Rate (%)
BMP4 (SN C22)	190	1	5	96.94
BTR72 (SN C72)	2	194	0	98.98
T74 (SN 134)	0	0	196	100
T74 (SN 814)	0	2	193	98.97
T74 (SN S9)	2	0	189	98.95
Average				98.39

Table 2 compares the procedure's performance to other SAR object identification algorithms. The greater discrimination percentage produced by the method demonstrates its efficacy. It includes particular references that give further context and information about the contrasted techniques.

Table 3 shows the thorough identification results obtained by the approach for several types of samples, emphasizing its exceptional performance.

It should be noted that the above-described embodiment is intended to demonstrate the current invention and should not be seen as restricting the scope of the invention. The spirit of the invention permits alterations and adjustments within the extent of the claims' protection.

5 CONCLUSION

Finally, a comprehensive experimental analysis was carried out utilizing the widely utilized MSTAR data set for Synthetic Aperture Radar (SAR) object recognition. The study sought to identify tertiary items recommended in the MSTAR data collection, with a special focus on three object classes: BTR72 (armored carrier), BMP4 (infantry combat vehicle), and T74 (tank).

The training and test sets were constructed independently, with the training set including 698 samples and the test set containing 1365 samples. The training set was improved by taking one model from each of the BTR72 and T74 subtypes. The example photos were all 128 × 128 pixels in size. The procedure used PCA magnitude downsized feature vectors acquired from convolutional neural networks with residual inaccuracy that had been trained using an adaptive optimization process referred to as Adaptive Moment Estimation. The vectors were then employed to achieve identification with a Support Vector Machine classifier with a radial basis kernel function. The technique had no performance issues in the identification, thus exceled every already published measure in the section. This included a 99.39% discrimination rate, a 97.28% percent accuracy value, a 99.46% recall rate, and an F1 value of 99.37%. The data clearly demonstrated that the technique was efficiency and excellent. The results were also summarized using detailed identification outcomes for different types of samples, indicating its performance. Furthermore, the mean percentage utilization for all categories is 99.39%. A comparative analysis with existing SAR object identification algorithms also indicated that the process had a higher mean discrimination rate. This certified the possibility of the procedure in recognizing SAR images. Therefore, the technique is efficient to be employed, as explicitly indicated by the study.

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Formation of centre for computing skills & career development (CCSCD) under graphic era society, Bhimtal Campus, Nainital (Local youth empowerment initiative)

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ABSTRACT: Nainital is located in Uttarakhand, India and is more famously known as 'the city of lakes' enriching scenic beauty and tourism activity. The place that has been recognized as supremacy in terms of schooling and university education & has continued to maintain the vibrant literacy statistics has quality teachers and other resources to update them at theoretical levels, but the place does not have a formal platform or a centre where local youth of the town and region could come together and discuss. Hence, this Paper is built on the faith of initiating a Centre for Computing Skills & Career Development (CCSCD) under the direction of GEHU Bhimtal, Nainital, which will draw attention of students towards changing socio-ecological dynamics at both micro and macro level and generate a level of awareness and confidence among them to discuss issues of priority and personal development.

Keywords: Nainital, Computing Skills, Career Development, Education, Youth Empowerment

1 INTRODUCTION

1.1 *Concept*

Nainital is located in Uttarakhand, India and is more famously known as 'the city of lakes' enriching scenic beauty and tourism activity. The place that has been recognized as supremacy in terms of schooling and university education & has continued to maintain the vibrant literacy statistics (annexure 1) has quality teachers and other resources to update them at theoretical levels, but the place does not have a formal platform or a centre where local youth of the town and region could come together and discuss, participate under the guidance of teaching fraternity on technical skills, the advance levels of computing field, growing importance of AI and ML and further discussion on various local/national/global social-economic-environmental issues & emerging career opportunities in various streams across the country and globe that could benefit them personally to clear their doubts and confusions. There is an imperative need to establish a Centre in the region that could address such issues. An importance of vocational guidance and counseling in assisting individuals through each stage of development, helping them to make informed decisions and navigate transitions in their careers has been experimented by various Psychologists [1].

Hence, this Paper is built on the faith of initiating a Centre for Computing Skills & Career Development (CCSCD) under the direction of GEHU Bhimtal, Nainital, which will draw

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attention of students towards changing socio-ecological dynamics at both micro and macro level and generate a level of awareness and confidence among them to discuss issues of priority and personal development. It is proposed to set up this Centre in the School of Management in consultation and guidance of The School of Computing, GEHU Bhimtal. A theory given by John L. Holland (1959) suggests that individuals are most satisfied and successful when their vocational choices align with their personality types, emphasizing the importance of self-awareness and matching individuals to suitable career environments [2]. At the same time, importance of seizing opportunities as they arise, being flexible in one's goals, and cultivating a mindset that is receptive to unexpected turns in life are other skills required in this era [3]. Hence, the Centre will also be a catalyst to align students interest with their career profile and develop a Psychological mindset to face challenges. The beneficiary will be all the students of the campus and later cover students of other campuses, schools, degree colleges as well. It shall also include a line of connection with the Schools in the town. As per one study an interplay between social, cognitive, and contextual factors in shaping individuals' career and academic pursuits is of high relevance and therefore career development has high impact of social and cognitive environment which shape the well-being of a person [4]. A small database would be maintained by GEHU students in the Centre where local, regional, national issues pertaining to computing, education, career opportunities, skill gap would be discussed and documented. Relevant issues would be disseminated through event/seminar and forwarded to related stakeholders, partners of relevance or policy makers as in the process of generating awareness in the region.

2 OBJECTIVES

Based on a 2P-2E Principle (Participate & Perform, Engage & Empower) the main objectives of initiating the Centre under the specified head CCSCD is to cover various areas of Youth involvement and ensure that:

Students Learn Basic and advanced IT/Computing skills, presentation skills, and develop Soft Skills Title, author and affiliation frame.

Students participate & are able to organize in-house 'events'- Seminars/GDs/lecture-series/Role-plays/cultural/Sports/outdoor activities under the guidance of advisors. Their experience will be documented in the website/blog and such participation will increase their self-reliance.

It aids to build confidence and personality of students in the region who are shy to turn up on stage and communicate their ideas given the fact that there is a growing cut throat competition in metro cities to build a good career.

Student groups are encouraged towards 'Field Projects' and gather primary data, understand 'Research Methodology & Data building. Generated data reports to be documented in a website/blog. Data analysis and data visualization will be the priority of project learning along with AI/ML applications.

It maximizes community, parents, and youth awareness regarding future career pathways and existing job openings; thereby leading to greater participation in education and helps to build a knowledge base around the region on contemporary practical socio-economic-ecological issues

It aims to build academic and institutional partnerships at a later stage by facilitating knowledge based exchange programs in between local schools/colleges and outside schools/universities. In consultation with industry experts from outside and academia in the town, it would assist Student Groups (SGs)of CCSCD to conduct 'awareness programs at school level' on social, environmental issues etc. CCSCD synchronizes theoretical knowledge to practical action.

3 EXPECTED OUTCOMES

Awareness and information on areas/issues of Intervention. (Table 1)

Bring a practical way of learning and hand-on experience on technical projects, event management skills by organizing role-plays/seminars/lecture-series/sports &cultural programs/outdoor visits etc.

Add experience and knowledge among the student groups (SGs) to develop their personality and be more self-reliant and confident to face the challenges after they pass out from Nainital to other big metro cities.

Bring team leading and team-work capabilities along with basics of discipline, punctuality & responsibility.

Understand their community and grassroots in a better way such as rural management and livelihood challenges faced by inhabitants in nearby villages including environmental issues and all of this through imbibing advance technical tools of AI/ML.

Establish a knowledge Mgt. System(KMS) of CCSCD consisting of books on leadership, career counseling, rural entrepreneurship cases, personality development and database of studies, discussions, events, tours or research undertaken by SGs. Disseminate information through various online sources such as blogs, facebook, twitter, website and other social networking sites as well as print medium.

Groups engaged in Field Research will get an insight on research and will be motivated towards PhD and research. They will also have an advantage of knowing the basics of research and application of technical tools.

Establish long term partnerships with other universities and Youth Forums to cross-exchange ideas.

4 MAJOR AREAS/VISION OF ACTION: TECHNO-SOCIO-ECONOMIC ECOLOGICAL ISSUES (TABLE 1)

Given the Economies of Scale to start, it is impossible to execute all the interventions simultaneously. The vision of action is to engage and facilitate issues and implement student engagements at micro level initially and with the passage of time and experience, gather financial-technical up gradation and scientific tools to uptake macro issues partnering other Universities/Institutes/Org. in the region or outside and spread awareness in the areas of concern mentioned in table a. Hence, it follows the Sequential methodology.

Table 1. Vision of action for initial 3 years from the start of Q1 (tentative).

Areas of Intervention	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
Education and Employment of Youth	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩
Environment and Climate Change					🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩
Communal Harmony, Moral & Cultural Development					🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩

4.1 *Publications*

(1st Year): Quarterly Newsletter or Patrika on Centre activities & community issues run by student groups (SGs). The Centre will explore some sponsorship opportunity for this publication.

4.2 *Online mediums*

(1st Year): Independent of newsletter/patrika publication, the Centre will immediately start a Website or a blog complimented with Social media.

4.3 *Media*

Liaising with Local TV Channels and news papers.

5 WORK METHODOLOGY

Activities will be purely based on Action Research where the motto of 'share and network totally' and the phrase *"think global, act local"* would be deep rooted into the system. The methodology will be based on the following pillars:

(1) Activation of Centre
(2) Research & Participation
(3) Advocacy
(4) Partnerships

5.1 *Activation of centre*

As soon as the Centre is formed, the activation will be based on the following-:

(1) Announcement/Awareness among students and departments about the Centre in the campus.
(2) Registration of member student groups (SGs) from campus and dividing the members into different clubs/groups. No registration fee shall be levied
(3) Start a website or a blog as soon as the Centre adds more than 20 members. The website/blog will provide general information and objective of the Centre. It will also include a column of student groups and their activities. No informal communication will be allowed in the group and all activities within the group will be closely monitored by the group moderator who will be the Centre Coordinator.

5.2 *Research & participation*

It will broadly carry:

(1) Event Participation (mandatory)
(2) Field Participation (non-mandatory)

This will be based upon identifying topics, planning and brainstorming and implementation wherever applicable as well as documentation. *'Event participation'* will be mandatory for student groups. However, 'Field Participation and Research' will be non-mandatory and self-motivated.

5.2.1 *'Event participation' will include*

(1) Role plays on themes of concern and that update awareness such as Environment, social change, women empowerment, rural resources, economic development, moral development.
(2) Group Discussions on selected topics that will enlarge student's horizon and knowledge.
(3) Extempore and on the spot public speaking that will enhance Students confidence and communication so that they are able to face the real world challenges and competition.

(4) Participate and organize in-house Seminars/Lecture Series/Workshops on subject related topics and debates within group members.
(5) Panel discussions and Personal Interview sessions of student groups (SGs), which give them a real time experience and practice on personal grooming.

5.2.2 *Field participation and research' or 'field work' will consist of*

(1) Forming different student groups (SGs)
(2) Giving names to these groups and dividing 'research topics' among them.
(3) Ask them to carry field research for few days/weeks after briefing them the 'fundamentals of research' such as data collection methods, tools of data collection and their application, analysis of data in excel and presenting the data results.
(4) Usage of AI/ML tools for data analysis and results under the able guidance of faculty members

5.3 *Advocacy*

CCSCD will advocate on matters of personal and professional issues on queries received from its members. This will include career advancement, contemporary job opportunities, skill gap and spread healthy lifestyle schedule and eliminate social tensions. The Centre will advocate students on simple but most significant themes such as technical upgradation, Resume building, Do's & Don'ts of an interview/GD, presentation and communication skills and many career related aspects'.

5.4 *Partnerships: (Initial Years)*

(1) Local institutions and local govt. bodies.
(2) Schools, University and affiliates

5.4.1 *Partnerships: (down the Years)*

(1) Higher govt. Authorities & Indian Corporate Sector engaged in Community development
(2) Foundations & Other reputed NGOs in the region and outside
(3) Universities and Academia
(4) International Agencies

The Centre will be taking assistance from its Chairperson, Advisors and other subject experts in all of these four pillars. Implementation of above will be done through Centre Coordinator.

6 GOVERNING COUNCIL

It is proposed to have a Governing council of Senior Academic & Industry experts to mentor the Centre and its activities. CCSCD progress will be monitored and evaluated by the Council as well from time to time. This proposal consists of Governing Council that shall include:

Veteran: Hon'ble Chancellor, Graphic Era University
Chairperson: Hon'ble Vice-Chancellor, Graphic Era University
Advisors: Director, Graphic Era Hill University, Bhimtal and Senior Faculty members
Centre Coordinator/s: Senior Faculty/s and Students

7 WORK METHODOLOGY

Figure 1 shown is highlights a *flowchart* on the process of Student's Participation in CCSCD for an 'Event Management Activity'.

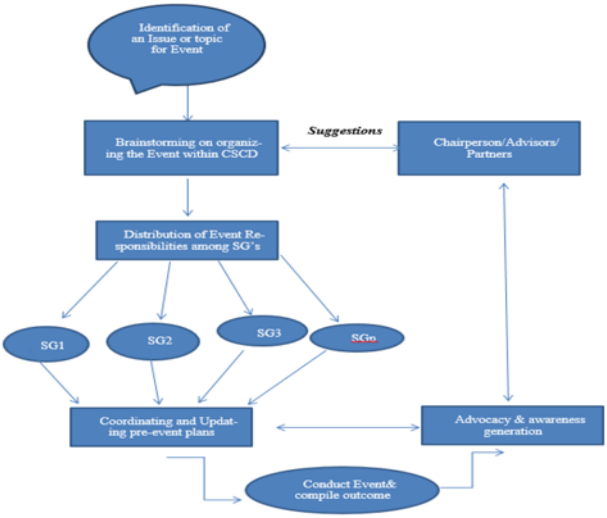
Identification of an Issue or topic for Event
Brainstorming on organizing the Event within CSCD
Suggestions
Chairperson/Advisors/ Partners
Distribution of Event Responsibilities among SG's
SG1
SG2
SG3
SGn
Coordinating and Updating pre-event plans
Advocacy & awareness generation
Conduct Event& compile outcome

Figure 1. (self-compiled) SG-student groups.

8 CONCULSION/SIGNIFICANCE OF THE PROJECT

(1) High Social significance in terms of generating awareness and action-based solutions to concerned issues through direct interface with the young community.
(2) High Academic significance as providing a platform to Volunteers from cross sections and student groups from Schools/University to Participate &Perform on the projects assigned. However, the Youth in the town gets enough exposure towards theoretical knowledge; he/she is left out to build upon the most needed practical knowledge and mediums of professional interaction and communication.
(3) Inkson and King (2018) in their study proposed a shift from traditional career management to a more proactive approach termed "career making" and the paper proposes a similar pragmatic approach to establish a centre that take care of an individual through both theoretical and practical approach.

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Impact of channel tapering on threshold voltage variation in multi-layer word line 3 dimensional NAND structures

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ABSTRACT: This work investigates the problems caused by the new multi-layer word line (WL) counts in 3D NAND flash memory, a technology that radically changes conventional memory designs. This study explores the effects of channel doping and taper angle on the electrical properties of vertical 3D NAND Flash memory to deliver issues related to increasing overall mold height and channel tapering. Operating Sentaurus technology computer-aided design (TCAD) tools, the investigation inspects the threshold voltage (Vth) appropriation among word lines (WLs) along the string. The goal is to assess current difficulties and propose a viable way to deal with achieving stable Vth dissemination. This includes breaking down the impacts of various shape points and channel doping levels on the electrical attributes of vertical 3D NAND flash memory. The results are expected to help improve the technology behind 3D NAND Flash memory.

Keywords: taper angle, channel doping, threshold voltage, NAND string

1 INTRODUCTION

The developing desire for lower bit costs and higher bit densities in non-unpredictable memory devices is driving research into new models to address the intrinsic hardships of planar NAND Flash memory. Vertical NAND flash memory innovations stand out because of their commitment to higher bit densities and less expensive bit costs than conventional planar gadgets. Vertical NAND flash memory technologies are quickly being seen as a suitable option in contrast to planar devices, with potential advantages including a lower bit cost and increased bit density. The 3D NAND memory architecture initially appeared in the industry in 2007 with the release of BiCS [1]. Since then, several vertical NAND flash memory architectures and technologies have been demonstrated, establishing new standards for bit cost reduction. [2–8]. There has been a lot of talk among research organisations regarding the latest breakthroughs and substantial physical impediments to the continued spread of 3D NAND memory. Grain boundary traps in the polysilicon channel, string height (mould height), cell-to-cell interference, and multilayer stacking over 96 layers to build more memory cells are some of the issues [9–13]. The taper angle in 3D NAND memory is analogous to the upward slope of the vertical walls within the memory cell structure as it moves through the stacked memory layers. The taper angle, which is regulated by the etching process during production, influences how efficiently memory cells work. Variation in the taper angle can influence the power utilization

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of memory cells as well as how data is moved upward in the memory stack. To guarantee the consistent performance of 3D NAND, engineers strive to obtain the ideal taper angle [14]. A correct taper angle can guarantee that memory cells perform effectively and don't cause issues while reading or writing data. The taper angle needs to be carefully considered all the way through the memory's design and manufacturing process. Engineers can utilize PC models and testing to find the optimal angle for keeping up with similar electrical properties across the memory stack's layers. Simply put, in 3D NAND, the taper angle has a significant impact on the performance and dependability of the memory cells in the stacked structure. Mold height and taper angle impact the electrical qualities of 3D NAND flash memory [15,16]. To guarantee a consistent threshold voltage (Vth) dissemination, vacillations in word line (WL) qualities should be limited along the tapering string [17]. Cell current (Icell) and voltage across WL transistors can be affected by irregular dimensions, which can result in variations in memory's initial and programmed states [17,18]. Analysts looked at what channel tapering means for the disseminations of Vth and Icell [17]. It was expressed that to get superior on-going and consistent program features, dimensions should be carefully maintained to restrict the taper angle. Although much work has been finished to address challenges with vertical NAND flash memory, nothing has had any significant awareness of the exact impact of the taper angle on Vth distribution. This work endeavors to close this gap by giving itemized data on the electrical properties of vertical NAND flash memory utilizing Sentaurus technology's computer-aided design (CAD) capabilities. The number of layers, taper angle, and cell position within a string are all carefully examined in the study, which focuses on devices with a tapered string. This examination looks at the perplexing connection between taper angle variation and threshold voltage in NAND devices. The review centers around what shifting etching angles and channel concentrations mean for threshold voltage. This offers us a sign of how much these things impact the threshold voltage. The findings of this study can be applied to the process of designing and manufacturing semiconductor devices.

2 LITERATURE SURVEY

The past investigation has focused profoundly on problems related to vertical NAND flash memories. Bhatt, U. M., *et al.* (2018) [11] the level of the structure increments with the layers of word line (WL) layers, presenting new problems for etching high aspect ratio channel holes. Bhatt, U. M et.al; (2018) [11], Bhatt, U. M., *et al.* (2020) [14], Channel tapering is the steady change in the width of the WL layers along the height of the channel. This causes the initial state threshold voltage (V_{th}) to vary from the top to the bottom WLs. To create almost equal vertical channels, careful etching management has been the focus of published research, Oh, Y.-T. *et al.* (2020) [17]. Alternatives to offset the taper, such as using different procedures or architecture-based techniques, have not, however, been documented and one more study explores the challenges encountered in evolving 3D NAND flash memory technology, specifically addressing issues like decreasing cell current and variations in critical dimensions, Nowak, E. *et al.* (2012) [18].

3 SIMULATION STRUCTURE

The structural characteristics of the simulated device are depicted in the figure. A detailed perspective of a 3D NAND string is shown in Figure 1, which also offers information on the stack specifics of individual word lines (WL). The 3D NAND simulations are carried out by simulating the device radially within cylindrical coordinates. One important factor to consider is the string's taper angle, which is shown in Figure 2. Simulations were run to examine and lessen the effects of channel tapering once the simulation setup was adjusted using the published data. During the device simulations, the following parameters are changed: taper angle and channel doping. A bit line (BL), a common source line (CSL), a string select transistor (SSL), a ground select transistor (GSL), word lines, select transistors, and a simulated vertical channel NAND structure are displayed in Figure 1(a). Every component of the simulated devices has a consistent thickness value. The measurements of the block oxide layer, nitride layer, silicon channel, and tunnel oxide are made at 15, 6, 5, and 10 nanometres, respectively.

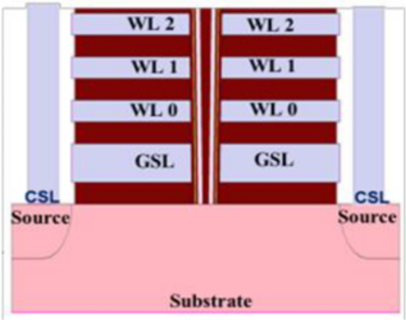

Figure 1. Structural properties of the simulated device.

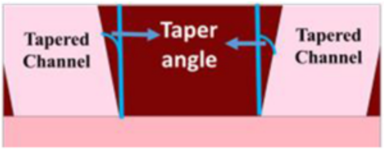

Figure 2. Taper angle: The angle of the vertically tapered channel.

4 RESULT & DISCUSSION

We constructed a short string consisting of 8 WLs and applied strong tapering to observe the impact of the taper angle on V_{th} distribution. In Figure 3, we examined the V_{th} Vs WL number for various taper angles (0, 2.5, 5, and 10 degrees). V_{th} dropped from the bottom to the top of the WLs when we adjusted the channel doping from 10^{15} /cm^3 to 10^{16} /cm^3. The different effective source/drain resistances throughout the string are the reason this occurred.

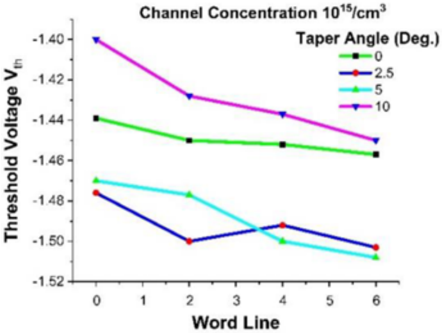

Figure 3. Initial state V_{th} versus WL number at 0°, 2.5°, 5°, and 10° Taper angles: Channel doping of 10^{15} /cm^3.

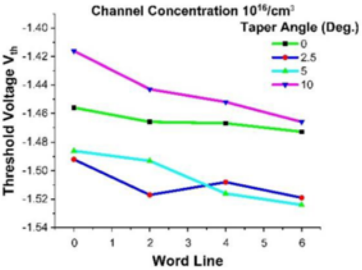

Figure 4. Initial state V_{th} versus WL number at 0°, 2.5°, 5°, and 10° Taper angles: Channel doping of 10^{16} /cm^3.

We observed changes caused by both the taper angle and the position of the WLs since the taper angle influenced V_{th}. V_{th} of the WLs was reduced in all cases when we increased channel doping. Thus, it can be deduced that an increase in channel doping results in a decrease in V_{th}. Additionally, at 0° of taper angle, the threshold voltage is essentially constant. Nevertheless, it is not feasible to obtain an exact zero-degree taper angle in 3D memory. As a result, in the fabrication process, a little taper angle is unavoidably added, and as the taper angle increases, the threshold voltage rises accordingly.

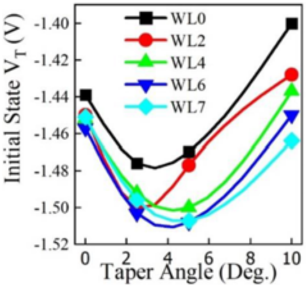

Figure 5. Variation of threshold voltage (Vth) with Taper angles for word-line numbers 0–7.

In Figure 5 We can compare the threshold voltage for several word lines at different taper angles using the accompanying figure, which provides insight into how sensitive the device is to changes in geometry. It establishes the foundation for comprehending how the taper angle affects the electrical properties of the semiconductor device, offering important details for the design and optimization of the device. This shows that variations in taper angle cause different word lines (WL0, WL2, WL4, WL6 and WL7) to respond in different ways. This implies that not all word lines have the same level of sensitivity to taper angle.

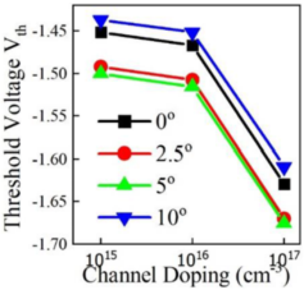

Figure 6. Simulated initial state V_{th} vs channel doping for taper angles of 0°, 2.5°, 5°, and 10°.

In Figure 6 there seems to be a trend of relatively constant threshold voltage within the doping level range from 10^{15} to 10^{16} per cm^3. In the denoted doping range, the threshold voltage values for the several taper angles (0°, 2.5°, 5°, and 10°) are fully comparable. This indicates that the threshold voltage is remarkably steady inside this doping range. Thus, Vth rises with the taper angle and reduces with channel doping.

5 CONCLUSION

This work investigates the effects of channel doping and taper angle on the fundamental threshold voltage (Vth) in 3D NAND flash memory. By increasing channel doping from top to bottom along word lines (WLs), we look for a regular Vth distribution at discrete locations within the memory string. The results provide useful comprehension of how to increase the string current and Vth distribution in 3D NAND Flash memory. It is significant to take note that Vth reduces with higher channel doping and increases with taper angle. The grounds for future developments in memory plan and enhancement approaches is reinforced by these revelations, which strengthen how we might interpret the basic components of changing memory performance.

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On-chip assessment procedure and calibration structure for aging durability assessment of integrated circuits

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ABSTRACT: In this article, we have proposed a quantitative evaluation approach and an on-chip calibration architecture to evaluate the aging reliability of Integrated circuits (ICs). The on-chip calibration architecture comprises a configurable ring oscillator, an edge detection circuit, and a test and control module. The return path of the configurable ring oscillator is used for calibration to achieve precise clock cycle. The matching path is integrated with the ring oscillator to configure the time delay of the buffer path to match the key path. The edge detection circuit enables the calibration of the matching path. The test and control module are used to control the processing mode of the calibration architecture. The calibration architecture can achieve in-situ calibration of the time delay of the key path under different power supply voltages, which can be used to predict the burn-in speed of the critical path. The aging reliability evaluation process involves a fast aging reliability assessment method for the IC. We also designed an on-chip calibration architecture for real-time time delay calibration of the key path during normal circuit operation to keep track of the aging process.

Keywords: Integrated circuit, aging durability, assessment procedure, on-chip calibration structure, configurable ring oscillator, edge detection circuit, test and control module, time delay calibration, critical path, burn-in speed, power supply voltage

1 INTRODUCTION

Modern electronic structures rely on Integrated circuits to power applications ranging from consumer electronics to automotive and aerospace structures. The need for more performance, more functionality, and less integrated circuit (IC) size remains key as ICs remain crucial. With this need, the need for aging durability of the ICs rises. IC's age when exposed to electrical stress, which is as a result of the thermal cycle and material depletion among other factors. Thus, the assessment of the IC's aging durability is of key significant in microelectronics [1–5]. The ICs aging durability involves the degradation of the IC's key

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components and of which basis the assessment is done. Aging mainly affects the critical path, and thus the key measurement to time delay of the process. The measurement of the process is done based on the time delays of the longest delay path of the circuit where real-time measurement gives the aging progression and IC failure mechanism. Traditional assessment methods involve accelerated aging test, temperature cycle, and stress tests, which leads to; prolonged test time, external calibrations stage, and numerous resources. There is, therefore, a need for a simplified method that ensures the measure of the time delay of critical paths, careering prediction speed, and the assessment of the aging process. The assessment we sought to present is on the novel assessment procedure and the on-chip calibration structure for the assessment of ICs. The procedure involves structure of the configurable ringed oscillator, edge detection circuit, and the assessment and control module. The ring oscillator plays the key part in the measurement of time delay along the critical direction. The structure is designed based on flexibility to adjust the delay characteristics of the path for accurate calibrating and matching of the buffers and key paths of the IC [6–10].

To conclude, this article introduces a new assessment process and calibration structure on-chip for evaluating the aging durability of ICs. An edge detection circuit, a test and control module, and a configurable ring oscillator make up the structure; the method allows precise time delay calibrations along the critical path . The procedure allows quick aging durability evaluation and prediction of the burn-in speed, as well as real-time monitoring of the IC's aging degree. These stunningly complex advancements in aging durability assessment pave the way for the manufacturing of high-quality, reliable ICs for more resilient and sturdy electronic structures throughout today's life. .8 It ensures the precise identification of signal edges and the alignment of the time delays of both the buffer and key paths [11–13]. The calibration can fully account for variations or disparities between the two paths through precise edge detection, increasing the aging durability and accuracy of calibrations.

2 RELATED WORK

An integrated circuit (IC) is a microelectronic device that integrates various components and their interconnecting wires onto a small silicon chip using semiconductor manufacturing processes. It offers significant advantages such as miniaturization, low power consumption, high durability, and cost-effectiveness [14–19]. ICs can be classified into analog, digital, and hybrid types based on their functions and structures. With the advancement of silicon technology, the gate length of advanced Complementary Metal Oxide Semiconductor (CMOS) devices continues to decrease. However, this reduction in gate length, without a corresponding decrease in supply voltage, leads to increased current density and exacerbates aging effects within the transistors. The aging effects in ICs primarily include static bias instability effects (NBTI), hot carrier injection effects (HCI), time-dependent dielectric breakdown effects (TDDB), and electron mobility effects (EM). Among these, NBTI and HCI are considered the main aging effects that determine the lifetime of an IC. Moreover, the aging effects become more pronounced in deep sub-micron ICs due to increased manufacturing uncertainties, resulting in varying burn-in speeds among different ICs. Consequently, even if IC chips pass structural and functional tests, they can still face failure problems during practical use due to aging effects [19–25].To address these issues, this research presents utilizing the initial threshold voltage of the critical path as a key parameter for assessment the aging durability of ICs and employs an on-chip test structure to rapidly test the initial threshold voltages of different critical paths [26–30]. The on-chip test structure offers high calibration precision and enables individual prediction of the aging durability of ICs while simultaneously detecting the actual aging condition of the circuit during use. A procedure to predict NBTI aging based on IDDQ testing published by K. Kang *et al.* in

2007 measured the leakage current of an IC in the standby state. This procedure, however, exhibited poor correlation to actual aging speed of critical paths and required an external testing device. Another aging prediction procedure based on measuring the threshold voltage was published by Velamina *et al.* in 2012, but the procedure required additional test equipment and lacked this testing modality as a part of IC design. A critical path fast-aging prediction procedure was based on the measurement of the initial threshold voltage of ring oscillator, and it was published by Wang *et al.* in 2014. By applying the initial threshold voltage of critical paths and utilizing the integrated on-chip test using multi-stage LFSR, this approach achieves precise aging speed prediction and provides real-time monitoring of ICs' aging condition. It hopes to provide a solution to the issue of implementation of robustness assessment of individual ICs, thereby fostering the advancement of more durable and reliable ICs. ICs and contribute to the development of more robust and reliable integrated circuits.

3 METHODOLOGY

This research presents an on-chip calibration structure for evaluating the aging of an integrated circuit based on the following three components: The control test comprises a configurable ring oscillator, edge detection circuit, and test and control module. The ring oscillator includes two transmitting triggers, a capturing trigger, a match path, and a return path. The mat path and return path were divided into general delay array and differential delay array, and each type's order represents the mat path's buffer delay can be fine-tuned precisely; another order presents the difference of buffer delays for different specification buffers. The return protocol was calibrated to make the time delay of the return path equal to one clock period. After calibrating the return and match path, connect them together to constitute a ring, and one obstacle frequency was focused generating from the ripple and the frequency. After removing the one clock period from the ripple and obtaining a loop ripple period, the periodicity is the time delay of the critical path to be measured. Edge detection circuit design is decisive in that the signal reached the same time to the matching path and the critical path. Each edge detection circuit has a two-pin gate, a two-pin OR gate, and a falling pole driving flip-flop. The whole purpose of the falling edge work flip flop is to make output upper level. That is, the choice between two ends means that the matching process of the critical path is completed. The control test is responsible for controlling the control vectors of the match and return paths to complete the calibration process. In addition, it can crosstalk the oscillation period of the control test ring fipple, and produce quality matrix and frequency data for further analysis and evaluation. On-chip calibration is a combination of the above components, a highly accurate on-chip calibration instrument for ICs that can precisely calibrate the ICs critical path block delay based on aging evaluation. This concept promotes a precursor to measure the aging of IC and maintain it.

4 EXPERIMENT AND RESULTS

In summary, the present invention includes a method and a testing circuit for evaluating the aging durability of an integrated circuit and the on-chip calibration structure for simulation and evaluation developed by the inventor. Testing was carried out in the HSPICE 2014 program to confirm the accuracy of the testing circuit in case of manufacturing uncertainty. The 28-nm process library was used when simulating the testing, and the VCS was used to perform the functional simulation of the test structure.

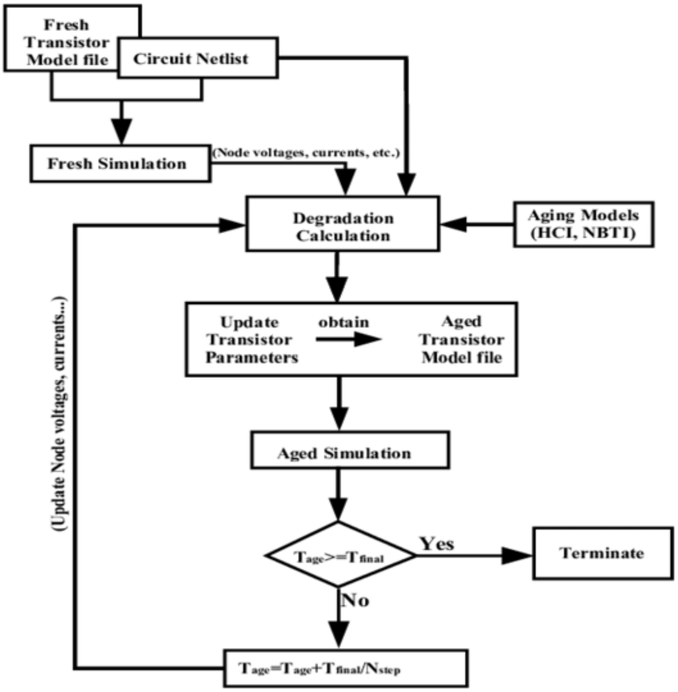
Fresh Transistor Model file
Circuit Netlist
Fresh Simulation
(Node voltages, currents, etc.)
Degradation Calculation
Aging Models (HCI, NBTI)
Update Transistor Parameters
obtain
Aged Transistor Model file
Aged Simulation
(Update Node voltages, currents...)
Tage>=Tfinal
Yes
Terminate
No
Tage=Tage+Tfinal/Nstep

Figure 1. A general process for simulating aging effects.

To consider the manufacturing uncertainty, the Monte Carlo SPICE method in HSPICE was used to further complicate the testing by introducing a variability model for 10% W(gate width), 10% L (gate length), and 25% Vth ((threshold voltage of the MOS transistor). When the on-chip calibration structure's power supply voltage is 1.05V, the average time delay difference of a single differential time delay unit is 2.760ps. After one year of aging, this value increases to 3.874ps, approximately half of the test accuracy value for the critical path. The delay-difference simulation structure of a single differential delay structure.

The on-chip calibration structure, designed by the inventor, is integrated into standard test circuits (ITC benchmark) and 64-bit floating point and graphic units from an open-source SPARC processor (OpenSPARC 2SPARC core). The insertion process is detailed in Figure 1.

Initially, RTL design, synthesis, scan chain insertion, and layout generation are conducted using EDA software for the original circuit. The durability assessment circuit is inserted into the original circuit layout using IC Compiler software, and layout and wiring are performed for the durability assessment structure. The total area and power consumption overhead introduced by the on-chip calibration structure, after integration into the reference circuit, are obtained and summarized in the table below. The on-chip calibration structure encompasses the overall footprint and the excess proportion of the circuit:

Furthermore, the procedure for assessment the aging durability of the integrated circuit was verified using FPGA. The experimental procedure involved measuring the time delay of a brand-new FPGA chip under different supply voltages (80°C, 1.801V, 1.788V, and 1.775V). The path time delay distribution of different chips under different supply voltages. By using the test data, the equivalent threshold voltage of the chip was calculated, allowing for the prediction of the aging speed and the assessment of chip durability based on the initial threshold voltage value.

Subsequently, an accelerated aging test was conducted on all the chips. The chips were divided into two groups, and static aging and dynamic aging were performed under aging conditions of 80°C, 1.8V power supply voltage, and 9 hours of aging time. The time delay value of the key path of the aged chips was retested. The actual aging speed of different FPGAs was calculated using the aged time delay value and the initial time delay value. A comparison of the predicted and actual burn-in rates for the chips. The experimental results aligned with theoretical analysis.

In the static aging group, data from 93 chips provided effective test results. All the chips underwent durability assessment based on the predicted threshold voltage values. Six chips exhibited inconsistent predicted durability grades compared to the actual grade, resulting in a durability assessment accuracy of 93.5%. In the dynamic aging group, data from 92 chips provided effective test results, yielding a durability assessment accuracy rate of 95.7%.

Table 1. Table comparing standard test circuits.

Standard Test Circuit	b19	FGU	Leon3s	VGA-LCD
Number of Critical Paths to be Measured	32	51	39	21
Cost of Power Consumption (%)	1.62	0.87	1.73	1.53
Area Overhead (%)	1.25	0.67	0.78	0.92

Thus far, a detailed description has been provided for the assessment procedure of the aging durability of the integrated circuit and the working principle of the on-chip calibration structure, including its structure and operation. The durability assessment procedure and the on-chip calibration structure offer several advantages:

(1) The procedure allows for assessment the aging durability of newly delivered integrated circuits, with testing time comparable to vector-based testing procedures. It offers the benefits of high testing speed and low testing cost.
(2) The provided aging durability assessment procedure is based on the time delay test result of the critical path, which can accurately represent the actual aging speed of the integrated circuit. It provides high prediction precision.
(3) The proposed path delay calibration structure calibrates the critical path time delay during normal circuit operation, without change the original circuit structure, therefore and exerts minimal influence on the original structure and timing of the integrated circuit.
(4) The proposed path delay calibration structure were constructed by pure digital devices, resulting in high calibration precision, fast feedback and response, and adding minimal area and power overhead.

It has been verified by software simulation that the designed on-chip calibration structure is feasible, and the area problem is discussed. Through the FPGA chip, the durability verification process of the calibration structure is successfully verified. Under the situation of static aging, the accuracy is 93.5%, and the error rate reaches 95.7% for dynamic aging.

5 CONCLUSION

In conclusion, the research presents a robust assessment procedure for aging durability of integrated circuits and the design and implementation of an on-chip structure for calibration. This project has also illustrated the experimental results and analysis that demonstrate the procedure and calibration structure's effectiveness and advantages. The research has started by verifying the procedure, using FPGA chips, measured the time delays of brand-new chips under varying supply voltages. The characterization of path time delay distribution was conducted to calculate the equivalent threshold voltage of the chips and predict the aging speed and assess their durability according to the initial threshold voltage value. Accelerated aging experimented on the actual chips provided data about the actual aging speed, then analysed in comparison with the acrial prediction based on the initial threshold voltage value. The various experimental results have indicated a good match between the theoretical analysis and experimental findings, validation the durability assessment procedure. Additionally, the on-chip calibration structure was designed and proven to not interfere with normal operation while still measuring the time delay of the critical path. The designed structure has a high precision with good speed in the response and remains minimal when checking for power consumption. The on-chip structure has been successfully simulated through software and further analysed in terms of area overhead on the circuit. These mitigations have several advantages, tested, and validated the effectiveness of this. The assessment procedure for aging durability of new delivered integrated circuits guaranteed low testing time and cost since only a few critical path-time delay calibrations are required. Moreover, the reliance of only vital path-time delay calibrations to estimate aging speed ensures the h edge of the prediction on the aging speed. Moreover, the designed on-chip calibration structure has proven to be practical and scalable. The structure verified digital devices and no other significant resources overhead. This project addresses future works studying the effect of roadkill path with asymmetrical effects, i.e. areas on the critical path edges of the path, shall be proposed in the new version. Hence the research is contributed to advancing integrated circuit durability assessment.

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Sign language recognition model

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ABSTRACT: People who are deprived of vocal communication or unable to apprehend speech face issues while interacting with people. To overcome this barrier the sign language came into existence. Sign language is different for different regions, Indians developed the Indian Sign Language (ISL). A lot of research has been conducted in the field of American Sign Language (ASL) and very less on Indian Sign Language. A probable reason for this may be the use of both hands in ISL usually increases the complexity of the solution offered technologically. Here we have proposed a methodology which is feasible and easily affordable by the users and completely based on ISL data. There is no requirement of sensory gloves. As an attempt to avoid the communication barrier we ought to present a solution combining the ISL based expert systems such as 3D avatar that can perform sign actions also inculcating a feature to recognize hand gestures from A-Z in ISL using deep learning. These disruptive systems can be utilized to spread the awareness of how important it is for normal people to know sign language to help people to understand each other better.

Keywords: Convolutional Neural Networks (CNN), Region of Interest (ROI), Tkinter, Natural Language Processing (NLP), Spacy, Indian Sign Language (ISL), American Sign Language (ASL), 3D Model, Blender, Speech Recognition, Sign Recognition, Deep Learning (DL)

1 INTRODUCTION

Normal people still don't pay much attention to sign language, despite how crucial it is for deaf-mute persons to communicate with themselves and with others. As hearing individuals, we usually don't give sign language much thought until we have deaf or hard of hearing family or friends. Making use of sign language interpreters is one way to communicate with those who are impaired of hearing or vocalization. Nevertheless, sign language interpreters are not cheap, and the majority of them only work with American Sign Language. The deaf-mute and the hearing-impaired need an affordable solution so that they can converse regularly. This is where the Sign Language Recognition System comes in handy. With any luck, the algorithm will be able to decipher the sign language and provide an English translation. In addition, we need a system that can render verbalized words or typed down text into sign language. To that end, we've developed a 3D low poly model of a human torso that can receive text input and translate it into sign language.

2 MOTIVATION AND PROBLEM STATEMENT

A dedication to promoting social inclusion is the driving force behind the development of Sign Language Recognition Systems. The prevalent social isolation felt by the deaf population is something this project seeks to address by promoting equitable opportunities.

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Reducing disparities caused by a lack of understanding is the main objective here. There are a lot of obstacles, such as the need for real-time processing, differences in signing styles, and the complex detection of different movements. Additionally, developers and academics are attempting to resolve the challenging issue of making these systems adaptable to different regional dialects and sign languages. Perfect hand gesture detection, character interpretation, text recognition, and 3D model execution according to user-defined rules are the hallmarks of an ideal system.

3 LITERATURE REVIEW

3.1 *3D avatar*

An ISL system that can render verbalized words or typed down text into appropriate enacted movements has been created by [6] Das Chakladar et al. 2021 using a 3D avatar as the basis. Three modules make up the system. The first step is to translate the spoken input into English. The next step is to use natural language processing to transform the English statement into its ISL equivalent. Lastly, the ISL sentence is used to specify the 3D avatar's motion. At the same time, Indian Sign Language (ISL) has a distinct advantage over other languages due to its clearly defined syntax, phonetics, morphology, and grammar. The initial module is concerned with translating spoken language into a text sentence, using NLP we will get appropriate ISL sentence. Finally, the recovered ISL text is fed into the 3D model in order to generate the corresponding actions. Made use of IBM Watson service for text-to-speech conversion and NLTK for English to ISL translation. After the text was pre-processed into Regular Expression, the text tokenizer was used to turn sentences to POS pairing.

3.2 *Sign language translation systems*

SILANT is a computerized transferal system that uses natural language processing and deep learning to construe from English language to actions of ASL [10]. To lemmatization are part of Phase 1, POS tagging is part of Phase 2, and a 3D animated avatar was part of Phase 3. The avatar was made in the Make Human program, and Blender was used for the animation. In addition, an LSTM-based paraphrase module is produced for POS tag sequencing. Finally, in cases where the animation database does not contain the sign for a specific lemma, a Synonym network is constructed as shown in Table 1.

Table 1. Overall working of SILANT [10].

Input Sentence	Intermediate Value	Rephrasal	Synonym
He clicked the photo.	HE CLICK PHOTO	Negative	Negative
Mona guffawed.	MONA LAUGHED	Negative	Positive
Cake is liked by me.	ME/I LIKE CAKE	Positive	Negative

3.3 *Recognition model*

[3] Gives us a rundown of various algorithms and strategies that could be used to construct a sign recognition system by reviewing various papers published in IEEE from 2015 to 2020. One approach that could work for our Sign Language Translator project is to collect data from a regular video camera and then classify it using a Convolutional Neural Network. This CNN has been utilized in Module 2 to build a robust classifier to effectively classify actions.

3.4 *ISL recognition model*

[5] Vipul Brahmankar *et al.* have used Canny Edge Detection Algorithm for differentiating features and extracted important vectors for classification of gestures. Canny Edge detection algorithm unfurls its multi-stage intricacy to discern a myriad of edges within images.

A way to identify hand motions by use of Convolutional Neural Networks (CNN) through Computer Vision (CV) was suggested by Rupali K. et al. [8] in 2023. In 2021, Aniket Kumar and colleagues presented a model that used OpenCV and CNNs through Keras to classify 36 ISL gestures, including the numbers 0-9 and the alphabets A-Z, and then to generate text representations of the corresponding gestures. To train and evaluate the CNN model, they used a dataset with 300 pictures for each motion. This model's astounding 99.91% accuracy rate on test photos is quite remarkable. Datasets were created using OpenCV and ROI approaches, and then trained on CNNs; this was the methodology.

4 PROPOSED METHODOLOGY

4.1 *Architecture diagram*

The model is built with two modules the first one is the 3D Avatar model or low poly human torso that can take text/speech input and convert it into ISL gestures. The other takes ISL gesture A-Z from ROI (green screen) and then predicts the letter. The detailed architecture is defined below Figure 1.

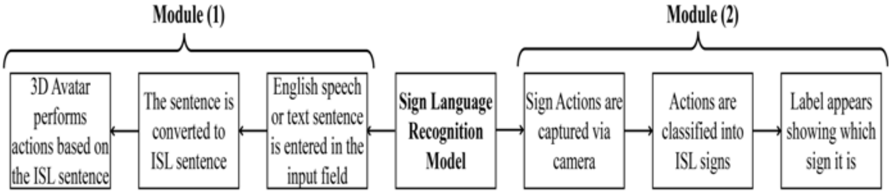

Module (1)
Module (2)
3D Avatar performs actions based on the ISL sentence
The sentence is converted to ISL sentence
English speech or text sentence is entered in the input field
Sign Language Recognition Model
Sign Actions are captured via camera
Actions are classified into ISL signs
Label appears showing which sign it is

Figure 1. Architecture diagram.

We utilize the Speech Recognition module in Python to access the application programming interface (API) of a speech-to-text service when the input is speech [6]. Blender is essential for creating and animating 3D models. The final window made use of each animation that had been created in Blender. You can now input text in two formats—spoken or typed finally, a SpaCy based on natural language processing will take an English sentence (Subject-Verb-Object) and, using POS tagging and letter rearrangement, convert it to an ISL sentence (Subject-Object-Verb). Architecture of Module 1 is shown in Figure 2.

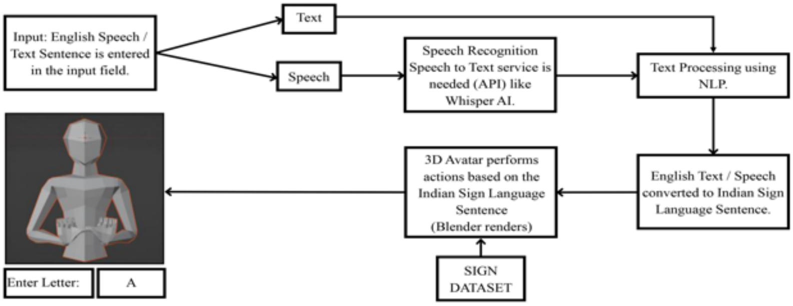

Input: English Speech / Text Sentence is entered in the input field.
Text
Speech
Speech Recognition Speech to Text service is needed (API) like Whisper AI.
Text Processing using NLP.
English Text / Speech converted to Indian Sign Language Sentence.
3D Avatar performs actions based on the Indian Sign Language Sentence (Blender renders)
SIGN DATASET
Enter Letter:
A

Figure 2. Module 1.

4.2 *Speech to text converter*

The Python Speech Recognition library, which is used by several APIs including OpenAI's Whisper AI and IBM Watson's Speech-to-Text, etc., was used to construct Speech to Text Converter.

4.3 *English to ISL generator*

This is made using a python script that utilizes the Tkinter library. The purpose of the application is to take a sentence input from the user, preprocess it using spaCy for tasks like removing stopwords, lemmatization, and rearranging the sentence into a (subject-object-verb) structure. Let us break down the working step by step as shown in the Figure 3.

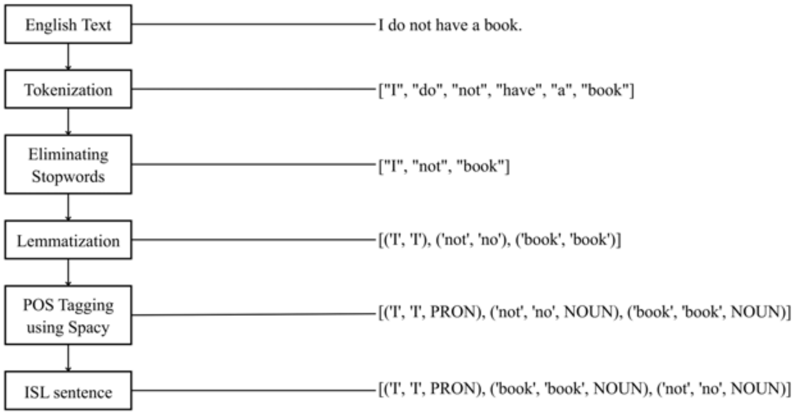

English Text
I do not have a book.
Tokenization
["I", "do", "not", "have", "a", "book"]
Eliminating Stopwords
["I", "not", "book"]
Lemmatization
[('I', 'I'), ('not', 'no'), ('book', 'book')]
POS Tagging using Spacy
[('I', 'I', PRON), ('not', 'no', NOUN), ('book', 'book', NOUN)]
ISL sentence
[('I', 'I', PRON), ('book', 'book', NOUN), ('not', 'no', NOUN)]

Figure 3. English to ISL sentence generator.

4.4 *Module 2*

The Architecture Diagram is shown in Figure 4. It has portrayed all the steps that we are following in order to build the solution. It is a real-time vision CNN based module that can recognize hand gestures and certainly classify the same on the character label it has been embedded with.

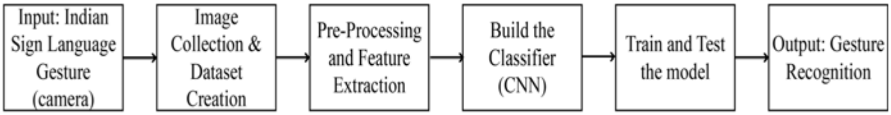
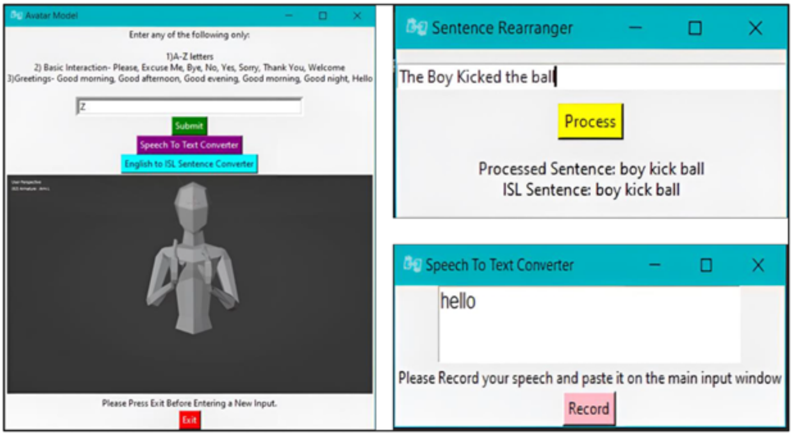

Input: Indian Sign Language Gesture (camera)
Image Collection & Dataset Creation
Pre-Processing and Feature Extraction
Build the Classifier (CNN)
Train and Test the model
Output: Gesture Recognition

Figure 4. Module 2.

5 RESULTS

Figure 5 shows the Tkinter-made root window (Avatar Model) of our system, which executes the actions for each word or letter as user inputs it. More than 40 animations have been rendered by us. You can see a video recording of the 3D avatar signing the appropriate ISL action for the input after entering the necessary text into the input field and clicking the Submit button. To start over with fresh input and hit the Submit button, we must close the window first. The Sentence Rearranger is an attempt to build an English to ISL Sentence Generator using NLP. The sentence is entered in the input region and as you press Process button two outputs become visible the first one is processed sentence and the other is the ISL sentence. The Speech to Text Converter captures your voice recording and then processes it through APIs and then provide a text transcript on the screen as in this case we have said “Hello”.



Enter any of the following only:

1)A-Z letters
2) Basic Interaction- Please, Excuse Me, Bye, No, Yes, Sorry, Thank You, Welcome
3)Greetings- Good morning, Good afternoon, Good evening, Good morning, Good night, Hello

Z

Please Press Exit Before Entering a New Input.

The Boy Kicked the ball

Processed Sentence: boy kick ball
ISL Sentence: boy kick ball

hello

Please Record your speech and paste it on the main input window

Figure 5. Avatar model, sentence rearranger, speech to text converter.

Figure 6. Is the Module 2 where A-Z ISL gestures are predicted using an ROI (green screen). The images undergo a transformation into grayscale before being gently blurred Gaussian Blur. and the last step constitute adaptive thresholding.

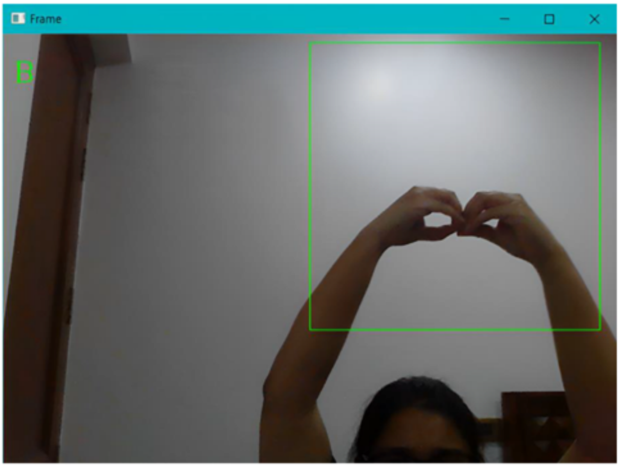


Figure 6. ISL sign recognition.

6 CONCLUSION

Sign Languages are divergent in each region. Their advent has proved to be a ground-breaking way of communication for those who are deprived of the ability to hear or communicate verbally. Sign language recognition systems represent a potent tool for synthesizing expert knowledge, detecting edges, and amalgamating disparate information from multiple sources. The goal of convolutional neural networks is to achieve accurate classification. The advent of a 3D model performing sign language will have an impact in the society. The most important characteristic of this project is to establish a cutting-edge platform dedicated to the community interacting Indian Sign Language. Our approach is to achieve two-way communication in which both sign-to-text and text-to-sign models are available. It can be further enhanced to enable facial features of the 3D model with more variety in dataset and training possibilities.

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Unravelling the power of AI: A comprehensive comparison of nutritional status – BMI and AI Tools

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ABSTRACT: Unhealthy eating habits developed during college days can significantly have a negative impact on body of students. Thus, eating habit should be assessed intermittently or nutritional screening can help to detect any deficiencies. Nutritional assessment if done by using AI based applications can help in accurate estimation and assist in proper diet counselling to students. A cross sectional study was undertaken to assess nutritional status 400 students studying in selected university. Anthropometric measurements were done to assess the nutritional status and was interpreted by WHO BMI (Body Mass Index) classification criteria. It was further compared with nowadays available AI tools which can help or support the traditional ways of assessing BMI. University level education on food selection is very important so that students can make healthier choices. Though snacking habits among youngsters is common and cannot be removed but if inculcating healthier snacking habits may help them to adhere to dietary guidelines. Even AI based apps can be designed which helps them to track their eating habits.

Keywords: BMI, Nutritional status, Students, AI tools

1 INTRODUCTION

Nutritional status plays a significant role in our overall holistic health and well-being. It is also an essential component of health care delivery system. It refers to the ability of body's ability to utilize nutrients for itself. [1] Understanding nutritional status is imperative as it helps to identify the deficiencies or excess which can directly affect out health. [2] It is also vital for identifying any deficiencies or imbalances that may impact health. Through nutritional status assessment one can make informed decisions about dietary choices and take appropriate measures to improve our well-being. [3] Further, the eating practices of individual plays a crucial role in identifying the occurrence of disease like hypertension, stroke, diabetes mellitus in early years of life as by. [4]

Food and meal choices by adults generally stem from earlier life experiences. If young adults were exposed to a positive meal environment throughout their childhood and learned to accept a variety of foods, the transitions will be easier and a positive nutritional status could be maintained. [5] Various changes incur during the early adult years which influences food habits. Eating breakfast is significantly important as it considered to be one of the most important meals of the day. [6] It not only provides energy to kick the day but also provides essential nutrients. [7] A good breakfast provides the required energy to focus on task at hand and concentrate on academics which leads to good academic performances. [8]

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2 LITERATURE REVIEW

If a person regularly skips breakfast, it causes deficiency of nutrients which affects their health. Haldar *et al.* stated that it also deteriorates their cognitive function and was supported by many research studies. [9] Khanna *et al.* states that body mass index (BMI) is the method of choice to identify one's nutritional status. It is calculated by interpreting the value obtained after getting weight and height of individual. [10] Despite its widespread use, BMI has certain limitations that need to be considered. One of the primary drawbacks of BMI is that it does not take into account the composition of body weight, such as muscle mass and fat distribution as a person having heavy muscle mass but healthy is categorised as obese. [11] Additionally, BMI does not provide information about specific nutrient deficiencies or imbalances, making it less comprehensive in evaluating overall nutritional status. There are very few studies that.

Artificial Intelligence (AI) on the other hand has revolutionized various industries, and the field of nutrition is no exception. AI tools provide a more comprehensive and accurate assessment of nutritional status by analysing various factors beyond weight and height. [12,13] These tools utilize advanced algorithms and machine learning techniques to process and interpret data, enabling a more personalized approach to nutritional assessment. By incorporating AI into nutritional assessment, we can gain deeper insights into our dietary habits, nutrient intake, and overall health.

Since, the pattern of breakfast skipping has become a common practice among students the researcher found the need to identify the Nutritional Status of students and compare the same with AI based nutritional assessment.

3 METHODOLGY

The study design adopted was cross sectional survey design with quantitative approach. A total of 400 students studying in selected University of Nainital District, Uttarakhand participated in the study. Convenient sampling technique was used for data collection. The samples for the present study were undergraduate students studying different courses in the University. After obtaining administrative permission from Institutional Ethics Committee and Heads of departments of selected course students, the data was collected. Subjects were explained about the study after which informed consent was taken. The respondents were assured about confidentiality of their responses. The tools used for data collection were: Demographic Proforma and Anthropometric Data. Anthropometric measurements were done by measuring weight and height. Nutritional status was determined by calculating BMI and interpreting as per WHO guidelines. The instruments used i.e. weighing machine and inch tape were calibrated.

4 RESULTS

It was found that of 400 samples, maximum 214 (53.3%) were males and mostly 260 (65.3%) students belonged to Hindu religion. Majority 251 (63.5%) students belonged to nuclear family and maximum 201 (50.3%) were non-vegetarians. (Refer Table 1) It was found that about 80 (20%) students were underweight and 50 (12.5%) were overweight. (Figure 1)

4.1 *Nutritional assessment AI methods*

In recent times AI has influenced many aspects of our life and nutrition is one of them, and we can expect significant influence of AI in the future. With advancing technology, AI tools will become more accurate, sophisticated, and accessible and will have a major say in all the fields of human lives. These tools will leverage advancements in data analysis, machine learning, and personalized medicine to provide even more precise assessments of nutritional status. Additionally, the integration of wearable devices and other health monitoring technologies will further enhance the capabilities of AI tools in nutritional assessment and even give suggestions which will effect dietary patterns. [14] In near future quality of life can be enhanced by using AI based nutritional assessment tools as one can keep track of their health and well-being. BMI tools are easily available online and widely used but when compared with AI based nutritional assessment tools, it is found they lack comprehensiveness in terms of other parameters which can be considered for nutritional assessment. AI tools uses multiple factors to evaluate one's nutritional status like physical activity, eating patterns, physical profile and genetic predisposition which helps in deeper analysis of individual considering various parameters. Thus, gives better picture of one's nutritional status considering even minimal changes. The commonly used tools are: goFOODTM, GoCARB, FatSceret, CALORIE MAMA and bitesnap. [15–20] Though AI has a promising future in nutritional assessment as compared to BMI tools, but its reliability and accuracy should also be considered with its limitations in usage. Figure 1 showing the distribution of students across normal weight, underweight, and overweight categories.

Table 1. Distribution of samples characteristics n = 400.

Sl.No.	Demographic Variables	Frequency	Percentage (%)
1.	Course		
	B.Sc. Nursing	100	25
	B. Pharma	100	25
	School of Management	100	25
	B. Tech	100	25
2.	Gender		
	Males	214	53.5
	Females	186	46.5
3.	Religion		
	Hindu	260	65.3
	Muslim	91	22.5
	Sikh	25	6.3
	Christian	24	6
4.	Family Types		
	Joint	251	62.7
	Nuclear	147	36.5
	Extended	02	0.5
5.	Dietary Habit		
	Vegetarian	199	49.8
	Non-Vegetarian	201	50.2

n = 400

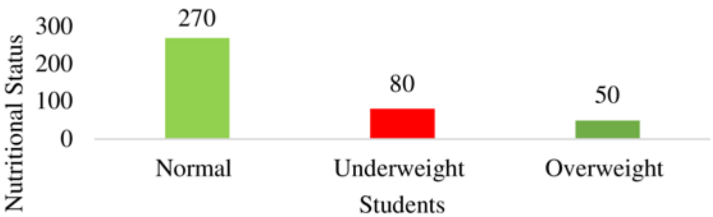

Figure 1. Nutritional status of students.

5 CONCLUSION

BMI scales has been a traditionally used tools for assessing nutritional status and generating basic data about a person's health. Even though these tools have been used for ages now, there are certain limitations in deriving accurate results about someone's nutritional practices and overall health. Incorporation of AI offers a more comprehensive and personalized approach to nutritional assessment by considering various factors beyond weight and height. Thus, it suggests that incorporating AI and BMI scales, will bringforth accurate detailed evaluation of one's nutritional status. Therefore, it is imperative to understand the advantages and limitations of both tools and choose the right tool. Whether it is BMI alone or a combination of both, the goal is to make informed decisions about our dietary choices and lifestyle habits to improve our overall health and well-being.

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Author index

Aadhavan, K. 669
Aarthi, B. 659
Abhishekh, S. 76
Abinaya, N. 659
Abirami, G. 47
Adgaonkar, A. 240
Adhikari, M. 266
Adithya Vardhan, A. 518
Adke, B. 36
Agarwal, J. 316
Agastya 82
Agme, V.N. 65
Ahalawat, K. 630
Aher, A. 36
Ajay, E. 476
Akash, R. 202
Akshaya, G. 804
Akurati, M. 30
Ali, S.M.S. 425
Ambade, P. 36
Anandaraj, S. 224
Ananya, R. 229
Anil Kumar, R. 792
Anirudh, J. 71
Ankaiah, B. 30
Antony Sophia, N. 141, 299
Apte, R. 36
Aravind, K. 173
Aravindha, S. 775
Aravinth, V. 476
Aravinthan, G. 173
Arivukarasi, M. 53
Arjun, K.S. 755
Arora, S. 636, 693
Arora, V. 299
Arshath, B. 353
Arthi, K. 855
Arunraja, R. 335
Arun Karuppiah, R. 71
Ashish 240, 780, 792
Ashwath Kumaran, T. 476
Ashwini, N. 761
Aslam Shareef, S. 749
Aswin, S. 173
Athish, C.B. 71
Awasthi, A. 124
Ayub Khan, P.M. 437

B.N., L. 240
Babu, K.M. 596, 804
Bajaj, A. 24
Balaji, A. 855
Balaji, M. 353
Balakrishna, N. 714
Balakumaran, M. 704
Balamurigan, S. 147
Baldawa, A. 24
Bamal, A. 709
Banga, M.K. 152
Barge, S. 24
Bartwal, R. 769
Basamsetti, A. 512
Basi Reddy, A. 431, 568
Begam, S.R. 743
Bhagat, S.K. 487
Bhagat, V.K. 266
Bhakuni, A. 60, 213
Bhambare, Y. 24
Bhandari, A. 60
Bhandarkar, S. 124
Bhange, A. 53
Bhanwal, G. 636
Bharathkumar, S. 704
Bhargavi, P. 743
Bhatt, C. 292, 481, 529, 583
Bhatt, K. 457
Bhatt, U.M. 842
Bhavan Surya, A. 353
Bhuvana Sri, N. 42
Bhuvaneswari, S. 726
Biradar, V.S. 88
Bisht, M.S. 836
Bisht, N. 191, 281, 359
Bisht, S. 191, 359
Biswas, B. 506
Boddupalli, S. 449
Bohra, N. 118
Boopathi, P. 704
Bora, B. 720

Chandana, Y. 341
Chandrashekhar, V. 53
Charitha, P.S. 749
Chaudhary, P. 94
Chauhan, R. 185, 218, 292, 375, 457, 481, 529, 583, 589, 613, 619, 648, 720, 769
Chhabra, G. 53, 130
Chilwal, B. 213, 524
Chinthamu, N. 375, 761
Choubey, C. 30

Dabke, Y. 261
Dasgupta, D. 619
Dautpure, A. 124
Deepa, B. 396
Deepadharani, M. 675
Deepak, S.N. 287
Deepan Raj, R. 653
Deepika, K. 755
Deepika, N. 141

Deepika, V. 261
Deetchanya, S. 675
Deopa, R. 830, 848
Devaki, M. 669
Devashree, E. 568
Devika, P. 413, 726
Devliyal, S. 292, 481, 529, 583
Dhami, R. 861
Dhanalakshmi, R. 769
Dhana Lakshmi, P. 816
Dhanik, K. 619
Dhanik, S. 830, 848
Dhanika, G. 755
Dhanush, S. 370
Dhanushiya, E. 370
Dharani, M. 512
Dharan Kumar, R. 568
Dharshan, K. 335
Dinesh, K. 607
Divya, R.K. 669
Donapati, P. 224
Dubey, A.K. 648
Dumka, R. 118, 524
Durupudi, N.R. 443

Farook, S. 418

G., S. 252
Gaikwad, A.S. 30
Ganesh, K. 407
Gangola, S. 14
Garg, A. 786
Garg, S. 431
Gayathri, N. 305
Geetha, S. 396
Geetha Priya, J. 780
Gill, F.S. 179, 322
Giri, S. 720
Gnanaprakash, C. 714
Gnanesh 82
Gobinath, K.S. 310
Goel, S. 213
Gokulkumar, K.P. 499
Gokul Prasath, S. 71
Gomathi, M. 499
Gopal, J. 653
Gopi, R. 816
Gopinath, C. 543
Goutham, P. 653
Goutham, S. 76
Govindaraj, M. 550
Gowri, R.S. 106
Gowtham, M. 173
Goyal, S. 276, 830, 848
Gupta, A. 9
Gupta, P. 577
Gupta, S. 179, 218, 577, 630
Gurupriya, M. 82, 518

Haldar, P. 276, 861
Harbola, A. 347, 698
Haribalasubramaniam, M. 476
Harikrishnan, V.S. 659
Hariprasath, L. 353
Harish, J. 704
Harish Kumar, A. 370
Hari Priya, S. 106
Heena 60
Heena 213
Heena 524
Hemalatha, C. 402
Hemanth 82
Hemathbhusani, M. 675
Hema Latha, K. 550
Hussain, I. 202

Indira Priyadarshini, Y. 271, 743
Indraes, R. 76
Indumathi, N.M. 653
Islabudheen, M. 147

Jadhav, S.B. 65
Jagadeesan, S. 755
Jagadish, R. 76
Jagadish Kumar, V. 240
Jaikumar, R. 464
Jain, A. 100
Jain, S. 786
Jakir Hussain, G.K. 76
Jamberi, K. 375
Janakiraman, V. 14
Jangirala, S. 30, 94
Jawade, A. 124
Jayadharshini, P. 659
Jayasurya, S. 136
Jeena, D. 524
Jeewankar, A.N. 234
Jerome Santiago, J. 94
John Victor, K. 202
Jonnalagadda, R.B. 470
Joshi, A. 208
Joshi, H. 191, 213
Joshi, M. 693
Juyal, A. 347, 698
Jyala, G.S. 613

Kadu, A. 24
Kandpal, V. 810
Kaparwan, S. 19, 534
Kapil, D. 9
Kapoor, V. 786
Kapruwan, A. 218
Karajgi, S. 550
Karthick, G. 167
Karthick, P. 396
Karthik, R. 246, 252, 256, 402
Karthikeyan, G. 755
Karuppusamy, S. 365, 687
Kasat, K. 425, 625
Kashif, M. 470
Kaur, S.S. 347
Kaushal, K. 625
Kavitha, S. 365
Kaviya, R. 310
Keerthi Krishnan, P. 669
Khan, A.S. 732
Khan, R. 506
Khani, N.S. 698
Kharde, Y. 431

Khedekar, L. 24, 36
Khullar, A. 112
Khwaja Moinuddin Basha, S. 714
Kiran, A. 449, 470
Kiran, C.S. 425
Kiran Babu, R. 664
Kodankandath, S.S. 641
Kousika, S. 167
Kovilpillai, J.A. 562
Krishnaiah, N. 375
Krishnan, B. 402
Kumar, A. 487
Kumar, C.N. 234
Kumar, D.S. 449
Kumar, E. 709
Kumar, M. 197
Kumar, M.A. 14, 234, 240
Kumar, V. 179, 322, 577, 630
Kumarappan, S. 147

Lakshmikanth, R. 607
Lakshmi Vara Prasad, G. 816
Lal, B. 761
Leela Rani, D. 407
Likitha, N. 418
Londhe, G.V. 14, 30, 402, 493

Madana Kumar Reddy, C. 88
Madhumitha, K. 775
Mahesh Babu, V. 341
Maheswari, G. 749
Manasa, T. 804
Manikandan, R. 681
Manikandan, S. 816
Manikanta, A.R. 443
Manikumar, T. 147
Manjula, A. 425
Manna, A. 589
Manohara, M. 407
Manu, M. 830, 848
Mareeswari, A. 305
Mathews, A. 562
Mathias, S. 229
Maurya, H. 112
Md Sohan, S. 607
Meenakshi, K. 825
Meenakshi Devi, P. 167, 370
Meher Chakravarthy, C.H. 42
Mehra, N. 9
Mehra, T. 709
Mehta, A. 112
Mehta, V. 47
Mendhekar, S. 124
Mer, A. 636, 693
Mirza, K. 830, 848
Misra, A. 197, 208, 636, 693
Moghe, D. 825
Mohamed Ismayil, M. 775
Mohanraj, A. 557
Moharana, B. 780
Moheshkumar, G. 167
Monika, T. 499
Monishwaran, K. 387
Mounica, M. 310
Murugan, S. 664
Mushraq, S. 437
Muskan, H. 229
Mythily, M. 641
Mythily, V. 136, 335, 365

Nachiappan, B. 65, 562
Nagadevi, D. 512
Nagar, S.S. 229, 246, 252, 256, 261
Nagarajaiah, K. 316
Nageswara Rao, D. 816
Naidu, J.R. 732
Nallusamy, C. 106
Nandhini Devi, S. 816
Narayani, M.V. 443
Nasir Akhtar Jamali, N. 167
Nautiyal, A. 100
Naveed, S.M. 437
Naveen, D. 387
Nawaz, A. 118, 266, 287
Nayak, M. 761
Neerugatti, V. 449, 470
Negi, D. 100, 347
Negi, G. 19, 534
Negi, H. 287
Negi, H.S. 9, 100
Negi, N.S. 100, 347
Negi, S. 534
Neha, A. 271
Nema, P. 603
Niharika, N. 202
Nithish, A. 607
Nithish Kumar, P. 464
Nithya, S. 71
Nitnaware, S. 124
Nuzhath Ameen, S. 252

Obaid, A.K. 792

Padma, Ch. 341
Padma, S. 732
Palani Murugan, S. 775
Paliwal, S. 281
Panda, S. 391
Pande, L. 810
Pandey, B. 118
Pandey, C. 698
Pandey, J. 60
Pandey, K. 281, 359
Pandey, S. 359
Pandit, A. 36
Pant, M. 381
Pant, Y.V. 786
Panwar, N. 100
Parameswari, S. 780
Pargaien, A.V. 213, 266, 524
Pargaien, S. 60, 118, 287, 636, 693
Parihar, B. 53
Parthiban, P. 648

Pathak, P. 322
Pathak, S. 583
Patil, S. 158
Patwal, P. 481
Petwal, S. 9
Pawar, M. 693
Pawar, V. 431
Phulre, S. 603
Pilli, D. 234
Ponnusamy, S. 53
Prabhu, K. 316
Prajapati, D. 457
Pranathi, B. 804
Pranathi, K. 271
Praneeth Kumar, Y.M. 518
Pranesh, S. 335
Pranith, R. 335
Prasad, A.B. 316
Prasad, K.S. 568
Prashanthi, G. 804
Prateek 112
Praveenkumar, K. 675
Pravin, N. 365
Preethika, P. 499
Preetham, R.S. 229
Preethishri, D. 328
Premnath, E.S. 136
Prerana, M. 246
Priyadarsini, S. 305
Priyadharshini, B. 799
Priyadharshini, N.K. 396
Priya Kalaivani, K. 141
Pujitha, M. 743
Purohit, P. 493

Rabiya Begum, D. 470
Radha, V. 562
Ragaventhiran, J. 147
Ragul, V. 328
Raj, S. 487
Rajasree, T. 714
Rajkumar, A. 328
Rajkumar, N. 557, 562
Rakesh, R. 42
Ramaswamy, G. 443
Rama Lakshmi, U. 418
Ram Nivas, D. 476
Rana, A.J. 60, 118, 266, 524
Ranjan, J. 130
Ranjithamani, A. 88
Rao, T. 9
Rashmikant, S.M. 391
Ravindran, S.K. 252
Rawat, A. 185
Rawat, D. 861
Rawat, R. 185, 457, 589, 613, 619, 648, 720, 769
Rawat, V. 347
Reddy, T.V. 443
Rehaman, S.M. 437
Rishikesh 82
Rithika, R. 726
Riyazuddin, Y.M. 234
Rohith, M. 136
Rohitha, M. 88
Roy, D.R. 240
Rubansanthosh, G.B. 413
Rudhish, S. 653

Sagar, V. 630
Sah, A. 836
Sah, A.N. 191, 359
Sahib, D.F. 94
Sai Durga, K.H. 512
Sai Kumar Nayak, B. 418
Sai Praneetha, B. 449
Sai Thrinath, B.V. 407, 418
Sameer Hussain, G.S. 732
Sam Chriswin, E. 799
Sandhya, A.R. 256
Sandhya, G. 271
Sanjai, S.A. 464
Sanjaikumar, S. 413
Sanjana, D. 261
Sanjay, C. 464
Santhiya, S. 659
Santhosh Kumar Reddy, G. 681
Saravanan, M. 94
Saravanan, N. 370
Saravana Kumar, U.K. 287
Saritha, S. 596
Satya Ganga Gowri, P.V. V.N. 42
Savitha, P. 675
Saxena, S. 292
Seema, S. 596
Seethalakshmi, V. 173
Sekhar, K.C. 512
Selvamuthukumar, S. 799
Selvavathi, M. 88
Sengupta, S. 197, 810
Senthil Kumar, K. 387
Seranmadevi, R. 14
Shaik, B.A. 443
Shaik, M.S. 224
Shalen Janet, S. 246
Shankar, M. 437
Shanmugapriya, K. 310
Shanmugaraja, T. 799
Sharma, A. 218
Sharma, P. 266, 287
Sharma, S. 47
Sharma, V. 322
Shashanka Sai, B.P. 780
Shavukarla Mounika, D.D. 271
Sidharth, R. 799
SimhadriAppanna, V. 407
Sindhura, K. 738
Singaram, M. 71, 173
Singh, A. 425, 761
Singh, A.V. 825
Singh, E. 855
Singh, M. 487
Singh, N. 709
Singh, P. 792
Singh, R. 769
Singh, S. 112, 487
Sivaranjani, I. 396
Siva Nageswara Rao, S. 341

Sobana, P. 704
Somasekar, J. 449, 470
Sowmiya, M. 396
Sravani, K. 749
Sreenivasa Rao, V. 493
Srilakshmi, A. 316
Srilakshmi, C. 761
Srimathi, D. 387
Srinesh, M. 687
Srinivasulu Raju, S. 202
Sri Dharshani Reddy, N. 681
Sri Krishna, A. 224
Sri Senthur Murugan, P. 687
Sruthi, N. 749
Subhashini, M. 305
Sudha, P.D. 743
Sudharshan Reddy, C. 407
Sugumar, K. 136
Suguna, M.D. 596
Sukanya 861
Sukumar, P. 136, 365, 402
Sunkari, V. 234
Surarapu, N.J. 224
Surekha, C. 65
Surya, S. 687
Susendiran, S. 431
Swarna, S. 726
Swarna Lakshmi, P. 141
Swetha, R. 413
Swetha Nallamangai, K.N. 659
Syed Abdul Kalam, S. 464

Taj, M. 42
Tarigonda, H. 550
Tewari, D. 197, 208
Tewari, S. 208
Thabjula, M. 664
Thakare, Y. 506
Thamseel Ahamed, S. 687
Thangam, S. 82, 518
Thapa, P. 276
Tharun, M. 413
Tharun Reddy, D. 664
Thatipudi, J.G. 425
Thellaputta, G.R. 568
Thenmozhi, M. 543
Thilagham, K.T. 568
Tirumala Venkata Srinivas, D. 664
Tomar, A. 185
Tomar, S. 19
Tulasi Radha, N. 550
Twikil, G. 14

Uday Kiran Raju, S. 607
Udgirkar, N. 65
Uma, P. 499
Uma Maheshwari, C. 596
Uma Sai, M.A. 518
Upamanyu, M.S. 256
Upendra, R.S. 229, 246, 252, 256, 261
Urvashi 810

Vanathi, D. 328
Vanishree, B. 328
Varadarajan, M.N. 557
Varsha, S. 596
Vats, S. 65
Vavilapalli, S. 431
Veena, K. 550
Venitha, E. 141
Venkatakrishnamoorthy, T. 512
Venkatesh, K. 147
Venkateswara Reddy, R. 493
Venketbabu, T. 375
Vennila, V. 375
Verma, A. 179
Verma, D. 698, 842
Verma, P. 130
Verma, R. 316, 698
Vidhyavathi, K. 714
Vidyarthi, A. 381, 842
Vignavi, G. 681
Vignesh, G.D. 493
Vigneshwari, M. 141
Vijay, S. 152
Vijayakumar, K. 792
Vijay Anandh, R. 493
Viji, C. 557, 562
Vijitha, N. 726
Vimal, V. 780, 792
Vinitha, P. 714
Vinoparkavi, D. 365
Vishal 191
Vishnu Vardhana Naidu, B. 94
Viswakiran, M. 732

Yadav, R.K. 88
Yadav, S. 786
Yakshith Sai, R.N. 681
Yamini Supriya, B. 402
Yashasvi, V. 246
Yaswanth, S. 418
Yena Prasad, V. S 261